No. 15640

United States Court of Appeals

for the Ninth Circuit

JOHN PHILLIP ZANNARAS, J. P. ROBINSON, JR., and U. S. TUNGSTEN CORPORATION,

Appellants,

vs.

BAGDAD COPPER CORPORATION, a Corporation,

Appellee.

Transcript of Record

In Two Volumes

Volume II
(Pages 327 to 661)

Appeal from the United States District Court for the District of Arizona

Phillips & Van Orden Co., 4th & Berry, San Francisco, Calif.—11-22-57

No. 15640

United States Court of Appeals
for the Ninth Circuit

JOHN PHILLIP ZANNARAS, J. P. ROBINSON, JR., and U. S. TUNGSTEN CORPORATION,

Appellants,

vs.

BAGDAD COPPER CORPORATION, a Corporation,

Appellee.

Transcript of Record
In Two Volumes

Volume II
(Pages 327 to 661)

Appeal from the United States District Court for the District of Arizona

Phillips & Van Orden Co., 4th & Berry, San Francisco, Calif.—11-22-57

JOHN PHILLIP ZANNARAS

was recalled as a witness, and having been theretofore duly sworn, testified as follows:

Cross-Examination

By Mr. Wilmer:

Q. Mr. Zannaras, as I recall, you testified in your direct examination that all of the 1944 water from Burro Creek was polluted to the extent you could not use it, is that right?

A. I wouldn't say that, most of '44.

Q. When did that pollution start? [360]

A. I don't remember.

Q. Did it start prior to '44?

A. I don't——

Q. You recall testifying in your previous trial as to when you say it was polluted?

A. No, I do not.

Q. Do you recall your deposition which was taken on July 2nd in Prescott in that case?

A. Yes.

Q. Pardon?

A. You refresh my memory. Now, that is seven years, now.

Q. You do not recall, I take it, at this time, when you say that pollution started? A. No.

Q. Well, as a matter of fact, in your complaint that was filed in that case—— A. Yes.

Q. You stated you had shut down in December, '43, because of the pollution of water?

A. Well, if I made complaint, I presume it is correct.

(Testimony of John Phillip Zannaras.)

Q. And then through the year '44 the water was polluted that entire year to where you could not use it, is that correct?

A. I can't remember the dates exactly. I [361] have to go back to the records and look up——

Q. Going back to your testimony yesterday, did you testify that the reason you didn't operate the mill in '44 was because the water was polluted?

A. Yes, that is right, '44, yes.

Q. Do you recall that your previous lawsuit was based on the fact that that pollution began in December, '43?

A. That is a question of record as to that complaint.

Q. I want to show you Defendant's M for identification, which is proof of appropriation of water. Did you prepare and sign and swear to that, Mr. Zannaras? A. Yes.

Q. This was signed by you on the 12th day of December, '44, was it not?

A. Yes, that is right.

Q. On the 12th of December, '44, for the purpose of obtaining this water right certificate referred to, you signed this affidavit? A. Yes.

Q. "John Phillip Zannaras, being first duly sworn, depose and say that I have read the above and foregoing proof of appropriation of water; that I know the contents thereof, and that the [362] facts therein stated are true." A. Yes.

Q. Now, one of the questions which was asked in this application, Mr. Zannaras, was the following:

(Testimony of John Phillip Zannaras.)

"State quantity of water that has been applied to use." And you answered that: "Three million gallons per annum," did you not?

A. That is right.

Q. "State date water was completely applied to use."—"November 4th, 1944."

A. Completely used it from the very beginning.

Q. During the 12 months preceding November 4th, 1944, you had been using that water, had you?

A. Yes.

Q. Despite the fact it was polluted?

A. I never used polluted water.

Q. Well, what is the difference, Mr. Zannaras, between—strike that. I am sorry. What did you use—where did you get the water out of Burro Creek that you used from November 4th, 1944, and the preceding year that amounted to three million gallons? A. I don't get the question.

Q. How do you justify the fact than on November 4th, 1944, you swore you used three [363] million gallons a year out of Burro Creek the previous year, made annual use of that amount?

A. Well, we used water from Burro Creek.

Q. I say in face of the fact you have heretofore testified under oath—— A. Yes.

Q. ——that you could not use the water from December, 1943, until——

A. I tell you it wasn't in '43.

Q. Just a minute. As I understand it, you have testified that beginning in December, '43, and on

(Testimony of John Phillip Zannaras.)
through '44, you had been unable to use this water because it was polluted, is that correct?

A. When it was polluted, at the time it was polluted I could not use it. At the time it was polluted, but it wasn't polluted all the time.

Q. Do I understand now it was not polluted all the—— A. Not all the time.

Q. It was available for you to have used it?

A. Yes.

Q. Why didn't you use it?

A. When it was not polluted, I used it for mining purposes.

Q. Now, Mr. Zannaras, the mill that you speak of is how far from your mine? [364]

A. About 10 miles.

Q. The only source you have got to get water out of Burro Creek for mining purposes is at the mill? A. Yes.

Q. Your camp and your residence during this time was at the mine?

A. No, both, your mine and mill.

Q. How much time do you stay at the mine?

A. At what time?

Q. During '42, '43 or '44?

A. It is a hard question to answer. I stay sometimes at the mine, I stay sometimes at the mill.

Q. How long does it take you to make a round trip between the mine and the mill?

A. About an hour and a half.

Q. That is 12 miles?

(Testimony of John Phillip Zannaras.)

A. No, about 10 miles, take about an hour and a half.

Q. And what facilities do you have for hauling water from the mill to the mine?

A. Oh, I had a truck and a big tank truck.

Q. What kind of a tank do you have?

A. 6,000 gallon tank.

Q. 6.000 gallon tank, and you would haul a thousand gallons of water every day from the [365] mill to the mine?

A. Any time we need it, yes.

Q. How did you get the 3,000 gallons of water which you used in the house out of the tank and to the house? A. Well, we filled drums.

Q. How many drums would you fill to get 3,000 gallons a day down to the house?

A. Well, we fill the tank, too; we carry water with the tank, too, for the house.

Mr. Wilmer: That is all.

(The witness was excused.)

Mr. Wilmer: Mark that for identification, please.

(Thereupon, the document was marked as Defendant's Exhibit N for identification.)

Mr. Wilmer: Mark this for identification.

(Thereupon, the document was marked Defendant's Exhibit O for identification.)

Mr. Wilmer: We offer at this time in evidence Defendant's Exhibit M for identification, being

proof of appropriation of water, particularly the portions comprising the answers to questions 5, 7 and 8.

Mr. Cox: What is the purpose?

Mr. Wilmer: The purpose is self-evident. [366]

Mr. Cox: It is simply on the credibility of the witness?

Mr. Wilmer: The purpose is self-evident. It is offered for all purposes for which it is material.

The Court: Well, object to it and I will admit it subject to your objection.

Mr. Lockwood: The same objection that was made before.

Mr. Wilmer: I wonder if I may release this to Mr. Smith with the understanding we will put a certified copy of it in the record?

Mr. Cox: Is there anything else to come from the Water Department?

Mr. Wilmer: There is a certified copy of the other certificate.

Mr. Cox: Which other certificate?

Mr. Wilmer: The one I have already offered and which has been admitted.

Mr. Cox: That is perfectly all right. You have any new certificate?

Mr. Wilmer: I have something new right now.

Mr. Cox: We would rather Mr. Smith not be released.

Mr. Wilmer: I am not releasing him. We offer that—we offer Defendant's Exhibit N for [367] identification in evidence.

Mr. Cox: You are offering N?

Mr. Wilmer: No, for identification in evidence.

Mr. Cox: We object to N for identification, upon the ground that it is merely an application for a permit, the application being dated January 9th, 1939, and a permit dated May 5th, 1939, for the construction of the diversion and appropriation of water in a manner that there is no showing that has ever been used, and under the law of the State of Arizona, unless there is a showing that that has been extended or had been completed, that the permit has expired and would have no materiality at all at this time, there being a five-year period stated on the instrument itself to be completed on or before May 5th, 1942, and this alone would be immaterial, in that if it has been completed and there has been a certificate of water right issued, that that would be proper evidence of any rights under the application that is shown on Exhibit N for identification. By the way, has this been identified in any way by any witness?

The Court: Identified——

Mr. Cox: Oh, it has just been offered.

The Court: I don't know where it came [368] from.

Mr. Wilmer: There is the signature and the seal of the State Water Commissioner, your Honor, on the permit.

Mr. Cox: May I recall Mr. Smith on voir dire?

Mr. Wilmer: Surely.

C. W. H. SMITH

was recalled and testified further as follows:

Recross-Examination

By Mr. Cox:

Q. Mr. Smith, would you refer to your file No. A-1251? A. Is that the application number?

Q. Yes, that is the application number—A-2078, I beg your pardon. In that, I show you here Defendant's Exhibit N for identification, which is, it purports to be, I am sure it is, a certified copy of the application in that file? A. Yes, sir.

Q. Has there ever been a water right issued on that application? A. No.

Mr. Wilmer: Just a minute. I will not object to the question if there has been a water right certificate, because there has not been one and [369] we don't claim there has been. It is our position that a permit for the appropriation is all that is required. If we see fit to go there and get ourselves a fancy certificate, we can do so and there is no requirement in the Statute, and the fact is we have been using the water for years.

The Court: I will admit it subject to your objection. I never heard of such a thing; you never did either.

Q. (By Mr. Cox): I'd like to know if, in this file, did the Water Department at any time send to the Bagdad Corporation forms for filing notice of completion in order to obtain a certificate of water right under that application?

A. Yes. On May 9th, 1942, a letter was sent to

(Testimony of C. W. H. Smith.)

Mr. Still, the General Manager, by Jesse Wanslee, State Water Commissioner at that time, enclosing forms of the notice of completion, and those forms were not submitted in this case.

Q. In that letter were they notified as to when the work was to be completed?

Mr. Wilmer: Just a minute, may it please the Court, the letter is the best evidence.

Mr. Cox: Just read the letter.

The Court: Read that into the record. [370]

A. A letter to Mr. J. W. Still, General Manager, Bagdad Copper Corporation, Hillside, Arizona. From Jesse C. Wanslee—by Jesse C. Wanslee, State Water Commissioner, dated May 9th, 1942, in regard to Application No. A-2078, Burro Creek Bagdad Corporation.

"Dear Sir: We enclose herewith forms for notice for completion and construction which are to be filled out in the above designated case. According to the terms of the permit, construction work was to have been completed on or before May 5th, 1942. Sincerely yours."

Mr. Cox: Was there ever a reply to that giving notice of completion?

A. Not in this case, no.

Q. Was there ever an extension granted of time for the completion of the work?

A. I don't see any.

Mr. Cox: There is none in there. There isn't any argument on that. All right.

(Testimony of C. W. H. Smith.)

Redirect Examination

By Mr. Wilmer:

Q. How long have you been with the Water Commissioner?

A. Since January 2nd, 1945. [371]

Q. So that all you are testifying to is from the records? A. That is right.

Q. I notice on the outside of this file, Mr. Smith, that there is a notation, that notice of complete application of water was made on May 5th, 1945, filed. That does not appear in the file. Do you know what happened to that?

A. No, I do not. I didn't notice that particular notation.

Q. Notice of complete application of water has been——

A. Oh, that is a ticker for the form to be sent to the applicant.

Q. Now, Mr. Smith—I don't like to mess this thing up, your Honor, but in view of counsel's position, I believe this file should be available for this reason: It shows that the matter was quite warmly contested. There was a protest by the Burro Creek Land & Cattle Company, and I believe by—no, by the Burro Creek Land & Cattle Company is the only one that apparently appears here. There is an order denying the protest which shows the Commissioner's investigation of the matter. It shows that the application was not one which was idly made. It shows that on August [372] 7th, 1941,

(Testimony of C. W. H. Smith.)

Howard J. Smith, on behalf of the Bagdad Copper Corporation, wrote the Honorable J. C. Wanslee, Water Department, Phoenix, Arizona, as follows:

"Dear Sir—" I will save putting the whole thing in the record, if I may read it.

Mr. Cox: Read it into the record subject to our making later objection.

Mr. Wilmer: "Dear Sir: For and on behalf of the Bagdad Corporation, we hand you herewith copy of permit for rights of ways for poles and lines concerning the crossing of public lands which relates to and will be used in connection with the water rights issued by the Department, No. A-2078, which we judge you may desire to file in connection therewith. Sincerely yours, Howard J. Smith."

In that connection there is filed an agreement between the Bagdad Copper Corporation, as permittee, in connection with this right—application for right to occupy and use certain rights of ways across public lands to the point of diversion, which was in '41.

Mr. Cox: Mr. Wilmer, if you are going to ask that that file be read in, then we have to go to the 1905 file, which I will avow shows that the [373] letter you have just read, together with everything subsequent to that, except for a letter of transmittal of a certified copy, and the payment for it, was because of an error in filing that Smith letter, and that the Bagdad requested a certified copy of their permit, and they were sent by the Water Department without permit A-2078, because there was no

(Testimony of C. W. H. Smith.)

opportunity of hearing, and after they got it and paid for it, they wrote back, as shown by the other file, and said they didn't want this at all, we need it for operation. It is on the file that you have introduced in evidence your water right on.

Mr. Wilmer: All I am trying to do is, to show that this water right was obtained in good faith in 1939, that there was activity on it and that we have diverted and have appropriated water out of Burro Creek.

Mr. Cox: You can't do that with that file.

Mr. Wilmer: I can do it with the permit. There is no magic in this certificate. The magic is to put the water where you can do the most good.

The Court: Oh, let's get through with this lawsuit.

Mr. Wilmer: I am offering in evidence Defendant's O for identification. [374]

Mr. Cox: May I ask the purpose of Defendant's O, Mr. Wilmer?

Mr. Wilmer: Yes.

Mr. Cox: Is it your contention this is also in existence? May I ask a question on voir dire of the witness?

Q. Will you see the letter dated October 11th, 1943, signed by J. W. Still, General Manager of the Bagdad——

Mr. Wilmer: I will withdraw this last application. I don't think it has any merit.

The Court: All right.

Mr. Wilmer: This last one, I don't know what is

in the letter, but I doubt if it has any probative value. The record may show that with counsel's acquiescence we will withdraw Defendant's O for identification.

The Court: All right.

Mr. Wilmer: That is all, Mr. Smith.

(Thereupon, the witness was excused.)

Mr. Wilmer: The defendant rests.

(Thereupon, a document was marked as Defendant's Exhibit N in evidence.)

DEFENDANT'S EXHIBIT N

Application No. A-2078

Permit No. A-1251

Permit
To Appropriate Public Waters of
the State of Arizona

District No. ....

This instrument was first received in the office of the State Water Commissioner at Phoenix, Arizona, on the 9th day of January, 1938, at 1:30 o'clock p.m.

Returned to applicant for correction, January 23, 1939.

Corrected application refiled, January 28, 1939.

Approved, May 5, 1939.

Recorded in Book No. 12 of Applications for Permit at page 2078.

/s/ JESSE C. WANSLEE,
State Water Commissioner.

Defendant's Exhibit N—(Continued)

Application for a Permit

To Appropriate Public Waters of the State of Arizona

Filed January 9, 1939, at 1:30 p.m.

I, Bagdad Copper Corporation, Hillside, Arizona, by J. W. Still, Gen'l. Mgr., of Hillside, County of Yavapai, State of Arizona, do hereby make application for a permit to appropriate the following described unappropriated waters of the State of Arizona.

1. The source of the proposed appropriation is Burro Creek, tributary of Big Sandy River.

2. The amount of water which the applicant intends to apply to beneficial use is:

For mining use, 105,120,000 gal. per year.

3. The point of diversion is located 445 feet South 28 degrees, 30 minutes East from the NW corner of Sec. 27; being within the NW¼ of the NW¼, of Sec. 27, T. 15 N, R. 10 W, G. & S. R. B. & M., in the County of Yavapai.

4. The water will be used for Copper Ore Milling in the NW¼ of the SE¼, of Sec. 4 and for .... in the ...., of Sec. ...., T. 14 N, R. 9 W, G. & S. R. B. & M., Yavapai County, Arizona.

Description of Works

5. Diversion Works: (a) Diversion will be by gravity, the diverting dam to be 4 feet in height (stream bed to overflow), 125 ft. long on top, and constructed of timber & brush.

(b) Description of headgate: Timber—one opening, 1 ft. x 3 ft.

(c) If water is to be pumped give general description: Triplex pump, driven by 80 HP Diesel engine to lift water 1025 ft. thru 7.27 miles pipe line.

* * *

Defendant's Exhibit N—(Continued)

6. (b) Pipe line: Diameter 6″ & 8″; length 38,385 feet; grade 25.3 feet per 1,000 feet; total rise from intake to outlet, 1,025 feet; kind, steel.

7. Distributing Works. 1 tank; Material steel, 60 ft. dia. x 10 ft., 211,500 gals. capacity.

8. Cost and Construction Schedule. The estimated cost of the proposed project is $31,000. It is proposed to begin construction within one year after the approval of this application, to complete construction within two years thereafter and to completely apply the water to the proposed use five years after the beginning of construction.

Description of Proposed Use

* * *

14. Mining Use. The mines to be served are copper, known as the Bagdad; located in ...., Secs. 3, 4, 5, T. 14 N, R. 9 W; 32, 33, 34, T. 15 N, R. 9 W, G. & S. R. B. & M. and owned by The Bagdad Copper Corporation.

The method of utilizing the water is in a copper flotation mill.

Will the water be polluted by chemicals or otherwise? No.

What disposition is made of water after use? To Marooney Creek in SW¼ of SE¼, T. 14 N, R. 9 W.

General

15. Are the maps required by the Rules and Regulations filed with Application? Yes.

16. The proposed point of diversion is on land of Public Domain.

17. The proposed conduit system is on land of Public Domain & State Land.

18. The land at the proposed place of use is owned by Bagdad Copper Corp.

19. Post office used by those living near the proposed point of diversion is Hillside & Wickiup.

Defendant's Exhibit N—(Continued)

20. Of the applicant's knowledge, has the water described herein ever been appropriated, claimed or used by others? Yes. If so, file a statement herewith furnishing names of former appropriators or users of the water, and supporting applicant's claim that the water is now subject to appropriation.

21. If the source of supply is a stream, state names and addresses of three water users from the stream below the proposed point of diversion; or, if there are no water users from stream below the proposed point of diversion, or if the source of supply is other than a stream, furnish the names and addresses of at least three residents of the vicinity familiar with the source of supply and the proposed use of water.

Answer to 20, above: The old Neal Ranch, about 2 miles below the proposed point of diversion has used water from Burro Creek for irrigation purposes on a small amount of cultivated land. This water is but a small part of that flowing, even in the dry season. The minimum flow is approximately 1,000 gpm and the Neal Ranch use will not exceed 75 gpm. For the above reason we believe that there is now in excess of 200 gpm subject to appropriation.

Land owners below proposed point of diversion:

Burro Creek Cattle Co., owner H. Cline, Hillside, Arizona (Neal Ranch).

G. C. Shellabarger, c/o G. Spurlock, Wickiup, Arizona.

BAGDAD COPPER CORPORATION,
Hillside, Arizona,

By /s/ J. W. STILL,
Gen. Mgr.
Signature of Applicant.

Order of Correction

State of Arizona,
County of Maricopa—ss.

This is to certify that I have examined the foregoing application, together with the accompanying maps and data, and returned the same for correction or completion, as follows:

Defendant's Exhibit N—(Continued)

In Par. 2, strike "0.445 cu. ft. sec. or." In Par. 3, strike out tie and insert tie to new point of diversion and correct description of 40 acre tract in which located. In Pars. 5(c) and 6(b), correct length of pipe line. In Par. 7, correct capacity of tank. Correct original map or prepare a new map.

In order to retain its priority, this application must be corrected, completed and refiled in the office of the State Water Commissioner on or before March 24th, 1939.

Witness my hand and seal of office this 23rd day of January, 1939.

[Seal] /s/ JESSE C. WANSLEE,
State Water Commissioner.

Application No. A-2078 Permit No. A-1251

Permit

State of Arizona,
County of Maricopa—ss.

This is to certify that I have examined the foregoing application and do hereby approve the same, and grant to the applicant a permit to appropriate the water described therein subject to the following limitations and conditions:

The amount of water appropriated shall be limited to the amount which can be applied to beneficial use and shall not exceed One Hundred Million (100,000,000) Gallons per annum for Mining Use. (This Permit shall in no wise conflict with the vested right of the Burro Creek Cattle Company.)

The priority of date under this permit is January 9, 1939.

Actual construction work shall begin on or before May 5, 1940, and shall be prosecuted with reasonable diligence and be completed on or before May 5, 1942.

Complete application of the water to the proposed use shall be made on or before May 5, 1945.

Witness my hand and seal of office this 5th day of May, 1939.

[Seal] /s/ JESSE C. WANSLEE,
State Water Commissioner.

Admitted and filed March 4, 1949.

The Court: Do you have any rebuttal?

Mr. Cox: Yes. [375]

PLAINTIFF'S REBUTTAL TESTIMONY

ARTHUR J. SEEDS

was recalled as a witness on behalf of the plaintiff in rebuttal, and testified further as follows:

Direct Examination

By Mr. Cox:

Q. I believe you testified you were somewhat familiar with Burro Creek, Mr. Seeds?

A. Yes.

Q. You were previously sworn here yesterday?

A. Yes.

Q. Do you know the source of Burro Creek?

A. Approximately.

Q. Have you been through that country?

A. No, not right through the district.

Q. Not through the district? A. No.

Q. How far up Burro Creek have you been?

A. I have not been up any further than the ranch where this water is, where this intake is now. It wasn't there when I was out there long ago.

Q. Had you previously—have you seen Mr. Zannaras' dam there, I mean at least where he is [376] diverting his water, at any other time, have you seen it up there?

The Court: That would be improper rebuttal.

Mr. Wilmer: Just a minute, I object——

The Court: Go ahead.

(Testimony of Arthur J. Seeds.)

Mr. Cox: You had been to that diversion point of Mr. Zannaras' at other times other than on the 17th?

A. Yes.

Q. And had he, under the ordinary conditions there, could he or couldn't he pump water out of the diversion dam that he had?

A. He did it. Before, there was plenty of water there the time I seen it.

Q. And at this time there was not?

A. No.

Q. I show you Defendant's Exhibit D in evidence and ask you if that is about the way his diversion point looked, is that the way it looked when you were there?

A. Yes, I imagine that I would take it to be that.

Q. Down below his diversion point, I show you Defendant's Exhibit E, pictures. Mr. Dickey testified the pools down below. Did you notice the water down below? [377]

A. Yes, there is pools down there.

Q. And how large are those pools, Mr. Seeds?

A. Well, I don't know. I'd have to guess on that because I never measured them, but I should say that that pool, the last time I seen it, it was probably 20 by 40, or something like that, in size; the depth of it, I wouldn't know, I wouldn't know if it was an inch deep or a foot. I never measured it.

Q. Could you see the bottom very clearly there?

(Testimony of Arthur J. Seeds.)

A. Oh, in parts of it you could see the bottom very clearly.

Q. You testified you had not been to the Bagdad diversion? A. No, I have not.

Q. And on October 17th, there was not sufficient water to operate the pump? A. No, no.

Mr. Cox: That is all.

Mr. Wilmer: No questions.

The Court: That is all, Mr. Seeds.

(The witness was excused.)

Mr. Cox: We rest.

Mr. Wilmer: That is all.

The Court: Do you want to argue this case Monday afternoon? I can give you about an [378] hour if you want, about 2:30.

Mr. Wilmer: That will be fine.

The Court: The Court will stand at recess.

(Thereupon, the trial ended at 4:55 o'clock, p.m. of the same day.)

[Endorsed]: Filed June 12, 1950.

In the United States District Court,
District of Arizona

Civil No. 221

JOHN PHILLIP ZANNARAS, J. P. ROBINSON, JR., and U. S. TUNGSTEN CORPORATION,

Plaintiffs,

vs.

BAGDAD COPPER CORPORATION,

Defendant.

Proceedings had and evidence taken in the above-entitled cause before the Honorable Dave W. Ling, Judge of said Court, in his courtroom in the United States Courthouse, Phoenix, Arizona, commencing on the 9th day of March, 1954, at ten o'clock a.m.

Present:

MR. JOSEPH H. MORGAN,
Appeared for the Plaintiffs.

MESSRS. SNELL & WILMER, By
MR. MARK WILMER,
Appeared for the Defendant.

Proceedings

The Clerk: Civil 221 Prescott. John Phillip Zannaras, et al., versus Bagdad Copper Corporation, for further hearing on the plaintiffs' petition for relief.

The Court: Are you ready? Call your first witness.

Mr. Morgan: I might make a statement, if the Court please, before we begin with the evidence.

The Court: All right.

Mr. Morgan: If the Court will remember, at the close of that other case, the matter was continued for further hearing, in order that a judgment could be entered, as we understood it, which would protect plaintiffs' prior water rights, with as little loss of water as possible.

I think that is what the court wishes to be advised of.

We have assumed, of course, that the defendant would submit the proof, since under the settled law, the prior appropriation is entitled to the water in its natural flow, that is, down the stream, unless they can show a more advantageous way of delivering the water without waste.

There are two decisions of the Supreme Court of Arizona that govern that case. The first [2*] is the Arizona Copper Company versus Gillespie decision, which was approved by the Supreme Court of the United States, 100 Pacific 465, 12 Arizona 190; and affirmed by the Supreme Court in 230 U. S. 46.

It was there held that he who is first in time is first in right. Subsequent appropriators cannot deprive him of the rights his appropriation gives, either by diminishing the quantity or deteriorating the quality.

***Page numbering appearing at top of page of original Reporter's Transcript of Record.**

Since that decision was entered, the Supreme Court of Arizona in the famous case of Pima Farms versus Proctor, 30 Arizona 96, 245 Pacific 369, laid down the same rule, but provided that in that case if the defendant, that is, the second appropriator, could let down the water in some other way rather than down the stream, he had a right to do it.

And I am going to, with the permission of the Court, quote very briefly from that case.

"An appropriator of water from a running stream is entitled to have it flow down the 'natural channel' to his point of diversion undiminished in quantity or quality, or, if diverted from natural channel by other appropriators for their convenience, to have it delivered to him at available [3] points by other means provided by subsequent appropriators at their expense; 'natural channel' being floor or bed on which water flows and banks on each side thereof as carved out by natural causes.

"Senior appropriator by means of wells and pumps from independent underground stream is entitled, as against subsequent appropriator, to have such stream level remain so that his means of capture and diversion as originally installed will not be impaired or destroyed for his uses, or in lieu thereof to have later appropriator deliver him his water in such a manner as to make it available for his use."

And it was held in that case that the later appropriator could, in lieu of letting the water down underground, let it down to the senior appropriator in a ditch or canal.

Now, as I see it, the only question that will be before the court is how this water can be let down by the Bagdad Corporation with as little expense, of course, and as little loss as possible.

Mr. Wilmer: I take it it might be advisable, if it please the court, if we briefly outline our position. [4]

I think that it might perhaps facilitate the handling of the matter.

We rely, if it please the court, on the case of Albion Idaho Land Company versus the NAF Irrigation Company, 97 Federal Second at page 439, which is a case almost, with minor deviations which are not material, we believe, squarely in point with the facts as we will develop them.

I would like, if I might, to read just from the head notes to avoid taking a lot of the court's time.

First of all, it recognized that it is contrary to public policy of both Idaho and Utah to permit waste of water. Which is of course true in this jurisdiction.

Then the court goes on to hold, and I think it possibly is worth noting, that strangers to a proceeding to establish a water right are not bound by it. In other words, in this particular case there was an adjudication with respect to water rights in the stream, to which these parties were not parties, and the court, citing numerous cases, held that the same principle applies to decrees rendered to adjudicate rights in using water not being strictly in rem. That is just in passing. [5]

"While ordinarily a prior appropriator has a

paramount right to divert water from his stream and a junior appropriator may not divert water unless waters flowing in the stream are in excess of amount which prior appropriator has a right to divert, if, due to physical conditions beyond control of appropriators, water flowing in stream will not reach diversion point of prior appropriator in sufficient quantity for him to apply it to beneficial use, then junior appropriator whose diversion point is higher on the stream may divert the water."

And, secondly,

"Where, due to seepage, evaporation, and channel absorption, water flowing in interstate nonnavigable stream having its source in Utah and flowing into Idaho, when the average flow was below minimums fixed by the decree, would not reach users in lower lands in sufficient quantities to afford a practical head for irrigation, the trial court properly awarded waters for use of upper lands during times the flow at the gauging station was below such minimums, [6] even if the rights of users in upper lands were junior in right to those in lower lands."

In this particular case, if it please the court, it appeared that, as in this area, there were seasons of the year when the water, due to natural conditions, would not, without at least great waste, reach the prior appropriator, who was lower.

In this particular case, the court recognized the rights of the prior appropriator, but said, You are to use your water during these seasons when you can use it.

In other words, specify when the water was to be

used by one, and when it was to be used by the other.

In that connection, I want to briefly call your Honor's attention to this: If we assume that Mr. Zannaras has a valid water right, which, for the purpose of this proceeding, we must, his water right is for 3 million gallons per year.

He testified that his mill had a capacity of 50 tons per day. It was testified on several occasions by Mr. Dickie, and I believe others, that the normal use of water, the normal duty of water with respect to this type of milling operation, is three to one. In other words, three tons of water to one ton of ore which is milled. [7]

If we take Mr. Zannaras' own figures, if it please the court, and assume instead of 50 tons a day, the capacity was 20 tons a day, and if we assume that he mills only three hundred days out of the year instead of 365, we still find that to run for those 300 days he must use 1,140,000 gallons more than his water right.

In other words, based on his own statement as to the capacity of the mill, and cutting that not in half, but down to 20 tons per day, and accepting the fact he is entitled to his water, still, for the full use of his water he is only entitled to run substantially less than 300 days in the year.

I didn't figure out what that would actually come down to, but I assume it would probably be in the neighborhood of 250 days out of the year.

The gauging records which were introduced in

evidence, and the other records all indicate that there was only a couple of months in the year when there is a water shortage.

We, therefore, believe that under those circumstances, rather than Mr. Zannaras electing to mill when there is no water, as he testified on numerous occasions, he never got ready to mill [8] until June, when there was not any water. That is our position.

Now, if I may briefly outline what we propose to show in this connection.

Now, we have had a series of very careful geological examinations made of the stream bed below the Bagdad sump down to Mr. Zannaras' point of diversion. We have surveyed it to where we can accurately tell the court exactly what the basin is.

We have had geophysical soundings made to determine the depths of the bed, and the type of the material. We will show the court, if it please the court, without question, we believe, and your Honor will recall that there was right above our point of diversion bedrock, where the stream comes out of the bedrock. Immediately below our point of diversion, and almost to the Kingman Crossing there lies an old channel, an old basin, which comprises approximately 13 hundred acres, 1374 some acres of river bottom. This lies in an old channel, which, instead of following the course of the Burro Creek past the Kingman Crossing, is running generally southwest.

Below the Kingman Crossing into Mr. Zannaras' point of diversion it is substantially [9] bedrock,

with approximately six to thirty-seven feet of gravels, and containing approximately 83 acres, so that we have a total evaporative area lying below our point of diversion and Mr. Zannaras' mill of approximately 82 acres.

We will show you by computations that the amount of water which Bagdad takes, during the season of the year when there is a high evaporation, and the discharge of this stream into the old channel and through the type of vegetation that fills it, is inconsequential.

In other words, if we pumped not at all from the time the shortage begins, it might increase the flow for three or four days, or a week, to Mr. Zannaras' point of diversion. Beyond that, the excess of water loss through evaporation is so high that our adding of five or six or seven hundred gallons per minute to the stream flow would simply mean that much more water to be drawn off into the air.

Therefore, based on the rule laid down in this Tenth Circuit case, which we believe is not only good law, but good economics, we believe we can show the Court that our use of water during this period couldn't possibly, other than the wet years, and then it wouldn't make any difference, operate [10] to give Mr. Zannaras any substantial increase in his use.

I will call Mr. Colville.

GEORGE W. COLVILLE

called as a witness for the defendant, having been first duly sworn, testified as follows:

Direct Examination

By Mr. Wilmer:

Q. Will you state your name, please?

A. George W. Colville.

Q. What is your occupation?

A. Chief Engineer for Bagdad Copper Corporation.

Q. What profession do you follow?

A. I follow the profession of engineer, and I am registered in the state.

Q. You are a registered civil engineer?

A. Yes, sir.

Q. In that connection, Mr. Colville, are you accustomed to doing a lot of surveying?

A. I am.

Q. In accordance with our request, did you make some surveys in connection with the Burro Creek area lying below the Bagdad sump and to Mr. Zannaras' mill? [11] A. Yes, sir.

Q. In that connection, Mr. Colville, I believe you were supplied with a legal description of the Zannaras point of diversion, as set forth in this application for a permit to appropriate water?

A. I saw it.

Q. Did you survey out that location?

A. I surveyed out the actual point of diversion.

Q. Did you survey out the point that he listed as his point of diversion?

(Testimony of George W. Colville.)

A. I plotted it from the original point as given.

Q. Now, is that a loose end survey, or did you tie it in? A. It is tied in.

Q. Do you have a map, Mr. Colville, which you prepared, which shows the result of your survey?

A. I do here.

Q. May I see that?

A. Yes. (Handing to counsel.)

Mr. Wilmer: I suppose we should go on, should we not, on our numbers, your Honor, or should we start over?

The Court: However the clerk wants to do it. It is immaterial. [12]

The Clerk: Defendant's Exhibit M for identification.

(Said document was marked as Defendant's Exhibit M for identification.)

Q. (By Mr. Wilmer): I will hand you Defendant's Exhibit M for identification, Mr. Colville, and will you please examine that and tell me with respect to that exhibit if it was prepared under your direction, and if it accurately represents a survey of Burro Creek, and also of the point of diversion which Mr. Zannaras has acquired?

A. It is. That is a map made from field surveys and notes under my direction, and by me.

Q. Now, this line up here, which indicates Burro Creek, is that the true present channel for Burro Creek? A. It is.

Q. This line which extends down to this par-

(Testimony of George W. Colville.)

ticular point where you have the red arrows at the bottom, what does that represent?

A. This red line is the location of the diversion point as set forth in Mr. Zannaras' water right.

Q. That represents the point he has applied for to appropriate water from Burro Creek? [13]

A. As I remember reading it, yes.

Q. How far is that from the creek itself?

A. It is about two miles.

Q. So the point of diversion which Mr. Zannaras has in his application and in his water certificate is not on the creek itself?

A. Not according to the surveys.

Q. Is the survey accurate? A. It is.

Q. Before I offer this—Mr. Colville, did you have an aerial survey of the U. S. G. S. of the Burro Creek area, or a portion of it?

A. We did.

Q. You have that with you?

A. I have it here.

Mr. Wilmer: May this be marked?

The Clerk: Defendant's Exhibit N for identification.

(Said document was marked Defendant's Exhibit N for identification.)

Q. (By Mr. Wilmer): I am going to hand you Defendant's Exhibit N for identification, Mr. Colville, and ask you if that is a map which you obtained, or which was obtained for you from the U. S. Geological Survey, showing an aerial survey

(Testimony of George W. Colville.)
of the Burro Creek below [14] the Bagdad point of diversion?

A. Yes, sir. It goes as far as the aerial photo shows, and the balance is made from field surveys and plotted thereon.

Q. At the top of the map where you have Pump Station, Bagdad Copper Corp., will you state what that is, please?

A. That is where our point of diversion is, that we were pumping out of the creek.

Q. And at the bottom, "A," Zannaras Pump Station, will you state what that is, please?

A. That is his point of diversion.

Q. Through actual field surveys, did you determine if this aerial survey was correct, with respect to the boundary line of Burro Creek?

A. Yes. It is.

Q. So that by actual surveys you have confirmed the fact that the general borders of the creek from our point of diversion down to the Zannaras point of diversion are as outlined in yellow in this map?

A. Down to the Zannaras point of diversion.

Q. Where the aerial survey stops, did you actually survey the creek bed on down to Mr. Zannaras' place?

A. Yes. Those were made by actual field [15] measurements made on this map.

Q. You have your field notes? A. I do.

Q. So I understand it, this snake-like thing from Zannaras' point of diversion, to what you have labelled Valley Floor—82.5 acres, represents an

(Testimony of George W. Colville.)
actual survey of the bed of Burro Creek from approximately the Kingman Crossing down to Mr. Zannaras' place? A. Yes.

Q. And from that point to the Bagdad point of diversion represents an actual survey of the bed of Burro Creek to our point of diversion above?

A. Yes, sir.

Q. And this Exhibit M for identification shows the actual survey of the center of Burro Creek, from which you took your measurements——

A. This survey of the Burro Creek from the Kingman Crossing down to the Zannaras point of diversion is the same as on the other map, made from the same notes.

Mr. Wilmer: We offer Defendant's Exhibit M for identification in evidence.

Mr. Morgan: No objection.

The Clerk: Defendant's Exhibit M in evidence.

(Said document was received in evidence and marked Defendant's Exhibit M.) [16]

Mr. Morgan: May I ask a couple of questions on voir dire?

Mr. Wilmer: Surely.

Q. (By Mr. Morgan): Mr. Colville, all these surveys you made were on unsurveyed land, were they not?

A. The survey made down to the point of diversion was taken in the central portion on surveyed land. But it is unsurveyed land.

Q. The actual plat covers only unsurveyed lands?

(Testimony of George W. Colville.)

A. No; part of it is on surveyed lands.

Q. Where is the surveyed land?

A. They are on there in faint lines. You will see section corners there.

Q. At the upper end?

A. Would it be all right if I pointed out?

Q. Yes.

A. From this point here, the Burro Creek, this section corner is surveyed lands in this direction (indicating).

Q. That is to the east?

A. To the east. To the west unsurveyed lands. The east corners here that are shown are unsurveyed lands.

Q. Then everything above the crossing is on [17] surveyed land? A. Yes, sir.

Mr. Morgan: All right.

Q. (By Mr. Wilmer): To get the record straight on this, everything to the east is unsurveyed land (indicating)? A. Unsurveyed.

Q. Looking at this exhibit, Mr. Colville, at the point where the yellow, the broad yellow ends, and you have an arrow reading "Valley Floor—82.5 acres" pointing to it. Where is the section corner there which is surveyed?

A. Right here (indicating).

Q. Right at the place where the arrow touches the spot? A. Very near the place, just north.

Q. What other section corners do you see there lying south of that?

A. This corner here (indicating).

(Testimony of George W. Colville.)

Q. What is that?

A. Sections 24, 19, 25 and 30.

Q. That lies to the bottom of the exhibit?

A. You will find it on the first exhibit that this is shown on, what we started the survey from.

Q. May I ask this: If, generally speaking, [18] the area which reveals the topography of the country is in surveyed area? A. It is.

Q. And the undepicted part, that was not in the picture taken, that is unsurveyed?

A. The part the picture is taken of is in surveyed territory, yes, sir.

Mr. Wilmer: We offer the exhibit in evidence.

Mr. Morgan: No objection.

The Clerk: Defendant's Exhibit N in evidence.

(Said document was received in evidence and marked Defendant's Exhibit N.)

Q. (By Mr. Wilmer): Now, Mr. Colville, did you make a computation of the area which lies in the basin below the Bagdad point of diversion, and above the place where the basin narrows down to a very narrow channel? A. We did.

Q. And what is the area?

How much acreage is there in this portion there?

A. 1,374 acres.

Q. Did you also by actual survey compute the amount of acreage which lies from the area at the bottom of the basin down to the Zannaras point of [19] diversion? A. We did.

Q. How much acreage is there in that channel?

(Testimony of George W. Colville.)

A. Eighty-two and a half acres.

Q. You have marked on here with an arrow, "Shaded Area, 1,374 Acres." That is the acreage in the basin lying below the Bagdad sump and above the narrow channel? A. It is.

Q. And where you have marked "Valley Floor—82.5 acres," that is the computation of the amount of area in the channel below what we generally call the Kingman Crossing? A. Yes, sir.

Q. Are the boundaries of that basin, and the channel below fairly well marked and defined?

A. They are well defined.

Q. With respect to the type of area below the Bagdad sump, and to approximately the Kingman Crossing, generally, what type of vegetation do you observe?

A. There is mesquite trees, and cottonwood trees, and various other trees, and the usual desert vegetation.

Q. And is it mostly gravels and sands, or, generally, from your observation, what type of [20] ground is it?

A. It is principally, on the ground observation, it is principally gravels and sands, and silts.

Q. From that point down to the old Kingman Crossing? A. Yes, sir.

Q. And from the Kingman Crossing down to Mr. Zannaras' mill, generally what is the condition of the bed of the creek?

A. Well, it is thin gravel sheet, as near as could be observed, over bedrock.

(Testimony of George W. Colville.)

Q. There is quite a little bedrock outcropping from there on out?

A. Quite a little bedrock outcropping.

Q. Have you had the benefit of an aerial view of the topography of the country? A. I have.

Q. In so viewing that area, George, is it quite apparent that there is an old channel which does not follow the bed of Burro Creek beyond the Kingman Crossing, or did you note that?

A. I wouldn't state that definitely.

Q. Now, at the time that this survey was made, which I believe was just recently—you did this just in the last several weeks, did you not? [21]

A. Yes, sir.

Q. Who accompanied you on that survey?

A. There was Horace Smith.

Q. Who is he?

A. He works for me in my office. And E. H. Girard, Jr.

Q. He is another employee?

A. He is another employee in my office.

Q. Who else? A. And P. L. Gable.

Q. They were all in your survey party, were they? A. Yes, sir.

Q. Who else?

A. E. L. Jones. And E. C. Roe.

Q. You had a complete survey party, is that correct? A. Yes, sir.

Q. Now, in addition to that, did you observe certain geophysical examinations being made of the area? A. I did.

(Testimony of George W. Colville.)

Q. By whom were those made?

A. Doctor Thiele.

Q. And what part, if any, did you play in those geophysical examinations? [22]

A. I was there when some of the readings were taken on the instruments.

Q. You observed him making his tests up and down the valley there?

A. Yes, sir; on several occasions.

Q. How long was Dr. Thiele there making this examination, do you know?

A. It was several days.

Q. He could tell us better than you could?

A. Yes.

Mr. Wilmer: Cross-examine.

Cross-Examination

By Mr. Morgan:

Q. How much time did you put on this survey?

A. Surveying from the old Kingman Crossing, as it is generally known, we spent two days in the field with field parties.

Q. That is down to the Kingman Crossing, you mean?

A. Yes; from the old Kingman Crossing down to the point of diversion.

Q. Two days on that?

A. No; one day on that.

Q. One day on that?

A. Yes. And one day on the other part of the

(Testimony of George W. Colville.)

map, from the section corner down to the point [23] of diversion as shown on the first exhibit.

Q. You just spent two days in the field?

A. Yes, sir.

Q. How did you measure all that territory in two days? A. Measured by stadia distance.

Q. No chain measurements, then?

A. No, sir.

Q. That is all the time you spent in the field on this? A. Yes, sir.

Q. How many hours a day did you spend in those two days?

A. Well, I would say it would run around nine or ten hours it took us on each day.

Q. Each day? A. Yes.

Q. Did that include the time you went down there and then back to the office?

A. Yes. It took about—it takes about half an hour to go from the office down to the Kingman Crossing.

Q. And a half an hour back?

A. Yes. However, on that time when we surveyed down there, we didn't walk the distance both ways, because we left the car at one end, and [24] only had to walk the distance once, and was picked up by another car at the other end.

Q. Now, then, Mr. Colville, you said something about the Zannaras point of diversion being two miles away from something. What did you mean by that?

A. That was from the—that was as it was in the

(Testimony of George W. Colville.)
application, as I saw it, and the measurements in the field.

Q. The application shows that it is near, the point of diversion is near the point of junction of Bonanza Creek and Burro Creek?

A. It said 11 hundred feet from that section corner.

Q. Doesn't it also refer to being at the junction point of Bonanza Wash and Burro Creek?

A. I didn't make a thorough study of that. It is possible it does.

Q. Do you know where Bonanza Wash is?

A. No, sir; not by that name.

Q. The original wash that comes right down there and runs into Burro Creek just about at the point of the Zannaras point of diversion?

A. I know where that wash is, but I didn't know it by that name.

Q. And it is just at about that point where [25] the diversion actually is, isn't it?

A. It is a little ways upstream from there.

Q. Yes. A. Just a short distance.

Mr. Morgan: Yes. That is all.

Redirect Examination

By Mr. Wilmer:

Q. Mr. Colville, referring to what the clerk has handed me from Civil 129 Prescott, Plaintiff's Exhibit 1, which purports to be an application for a permit to appropriate public waters in the state of Arizona by John Phillip Zannaras, referring to Subsection 3. Will you read that, please?

(Testimony of George W. Colville.)

A. Point of diversion is located 1,100 feet north, 67° 30′ West from the Southwest Corner of Section 19, Township 14 North, Range 10 West, Gila and Salt River Meridian.

Q. Is that the point you located on Defendant's Exhibit M in evidence as two miles from Burro Creek?

A. That is the point that is plotted up in red on that map.

Q. Which is approximately two miles distant from the creek? A. Yes.

Mr. Wilmer: I think, if the Court please, [26] this exhibit is already in evidence in this case. Therefore, I will not re-mark this particular exhibit, but I will return that to the clerk.

That is all.

Mr. Morgan: Just a minute. Could I see that?

Recross-Examination

By Mr. Morgan:

Q. This particular section referred to in this application is unsurveyed, isn't it?

A. No; the section adjacent to it is.

Q. The section referred to in this application is—— A. I think it so states there.

Q. Unsurveyed? A. I believe so.

Mr. Morgan: That is all.

(Testimony of George W. Colville.)

Redirect Examination

By Mr. Wilmer:

Q. George, not to quibble about it—as I understand this, and you tell me if this is correct, the beginning point from which this point of diversion is stated is in surveyed area?

A. It is in surveyed area, and is observable in the field. I personally found it.

Q. You don't know how long it has been surveyed, [27] I presume?

A. No; I couldn't say.

Q. But you did find the southwest corner of Section 19, Township 14 North, Range 10 West G & SRM, Gila and Salt River Meridian, being within the Southeast quarter of the Southeast Quarter of Section 24, Township 14 North, Range 11 West, G & SRM in the County of Mohave, the beginning of this is in surveyed territory? A. Yes, sir.

Q. And ascertainable without difficulty?

A. Yes, sir.

Q. One other thing I might ask you, just to show the method by which you conducted this survey. May I have this other exhibit, please?

Mr. Wilmer: May this be marked for identification?

The Clerk: Defendant's Exhibit O for identification.

(Said document was marked Defendant's Exhibit O for identification.)

(Testimony of George W. Colville.)

Q. (By Mr. Wilmer): Referring to Exhibit O for identification, will you tell me what that is, please?

A. These are cross sections of the Burro Creek basin below our point of diversion, that were [28] taken in the field by field surveys.

Q. This shows the actual result of your survey in the way of a plotted cross section of the bed of the creek? A. It does.

Q. Did you follow this same method all up and down the creek in determining the extent of the boundaries, and the extent of the area within the boundaries?

A. This was check points up the creek to establish the width of it.

Q. This was the method by which you checked the aerial map to be sure it was accurate?

A. Yes, sir.

Q. Was this method of surveying you have described, was that one which has been recognized as an accurate method of making an accurate survey?

A. It is for the purposes of this survey.

Q. How long have you been an engineer?

A. Since 1937.

Q. 1937? A. Yes.

Q. Have you been actively engaged in the engineering practice—in the practice of the engineering profession since that time?

A. I have. [29]

Q. Of what school were you a graduate?

(Testimony of George W. Colville.)

A. I am not a graduate from the school. I attended the Ohio State University.

Q. Which university?

A. I attended the Ohio State University.

Q. Has your work, since you have been working as an engineer, been, a lot of it, involved with survey maps? A. A considerable part of it.

Mr. Wilmer: That is all.

Mr. Morgan: Just one minute.

Recross-Examination

By Mr. Morgan:

Q. Exhibit O for identification generally covers what territory?

A. That covers the basin between the Burro Creek crossing and our pump, the lower part of it.

Q. That is to the north of the Kingman Crossing? A. North of the Kingman Crossing.

Q. And the purpose of that is what?

A. Was to establish the width of the alluvial materials in the basin, and the width of it.

Mr. Morgan: No objections.

Mr. Wilmer: I offer Exhibit O in evidence.

The Clerk: Defendant's Exhibit O in [30] evidence.

(Said document was received in evidence and marked Defendant's Exhibit O.)

Mr. Wilmer: That is all.

(Witness excused.)

HEINRICH J. THIELE

called as a witness in behalf of the defendant, having been first duly sworn, testified as follows:

Direct Examination

By Mr. Wilmer:

Q. Will you state your name, please?

A. Heinrich J. Thiele.

Q. Where do you live, Dr. Thiele?

A. I am living in Tempe.

Q. How long have you lived there?

A. Since May, 1953.

Q. Doctor, what universities are you a graduate of?

A. I graduated from the Clausthal School of Mines in Germany, and the Montana School of Mines in Butte, Montana, and Technical University of Berlin in Germany.

Q. Tell me when you first graduated from the first university you named, Doctor? What was the year when you first got out of school?

A. 1936.

Q. Then I believe you attended the [31] Montana School of Mines?

A. The Montana School of Mines. I got my Master's degree.

Q. When was that? A. 1937.

Q. You spoke of a school in Germany. When did you graduate from that? A. 1936.

Q. Then you came to this country, did you?

A. Yes, sir.

(Testimony of Heinrich J. Thiele.)

Q. And attended the Montana School of Mines?

A. I did.

Q. After you got your Master's degree from the Montana School of Mines, you then returned to Germany?

A. I returned to Germany and was working as a geophysicist, and employed by the state in the Geophysical Institute in Potsdam.

Q. You spoke, then, of graduating from another university in Berlin? A. Yes.

Q. Which was that?

A. Technical University in Berlin, Charlottenberg.

Q. What degree?

A. Engineering degree, mining engineer.

Q. What degrees do you have presently? [32]

A. Doctor's degree in engineering, Master's degree in Mineral Dressing, and Engineering degree in Mining Engineering.

Q. Will you tell me, Doctor, when you were in Germany, what particular type of work you did there?

A. Since 1942, I am a ground water consultant.

Q. When you were in Germany?

A. In Germany.

Q. What did your work consist of in that respect?

A. The water supply, and the research for ground water deposits for states, communities, cities, larger industries.

Q. That is, for the purpose of consultant with

(Testimony of Heinrich J. Thiele.)

respect to underground water supplies, and available sources of underground water?

A. Yes, sir. I made a large study of the whole country for the amount of water that is available, and where to start, and where it can be found.

Q. Since you have been in this country, Doctor, have you done any underground water studies in the valley?

A. Yes; I have done that for the Water Users Association in Phoenix. [33]

Q. How long did you spend for the Water Users in making the study which you made for them?

A. I started in May 1st, 1953.

Q. And that was with respect to what investigation, what type of investigation?

A. It was ground water geological, hydrological, and geophysical investigation.

Q. Have you done any similar investigations for any other groups or people in the valley, Doctor?

A. I started with a similar investigation for the Indian Service, for the Indian Council in Sacaton.

Q. In addition to that, are you generally practicing as a consultant with respect to ground water in similar matters? A. Yes, sir.

Q. In connection with your education, Doctor, and I presume your continuing education since, have you prepared any scientific papers?

A. Yes, sir. I published part of a textbook in 1952, and some other papers. Here are the papers (handing to counsel).

Q. With respect to the State of Arizona Under-

(Testimony of Heinrich J. Thiele.)

ground Water Commission, have you acted as a consultant for that group?

A. Not for the State Underground Water [34] Commission, but I was working together with the secretary of the Commission.

Q. I believe you live in Tempe?

A. I am living in Tempe.

Q. Have you done any work in connection with any of the teachers at the Tempe School, of a scientific nature?

A. I am working together with some of the scientific teachers in the college.

Q. Tell me, Doctor, with respect to this old world of ours, do underground water conditions vary in accordance with the race of people that lives above them, or are they pretty much the same, generally speaking, everywhere?

A. The underground water conditions changed quite a bit since the population increased.

Q. I meant by that, Doctor, conditions with respect to underground water in Germany, for instance, or in England, or in Arizona, they vary some, but substantially they are pretty much the same?

A. No. All these underground water conditions obey the big hydrological cycle.

Q. The scientific principles that are involved do not vary with the nation occupying the soil at that time? [35]

A. That is right. In some countries you have higher evaporation, and some countries higher rain-

(Testimony of Heinrich J. Thiele.)

fall, but the basic principles are the same everywhere around the world.

Q. Now, Doctor, in making a study of water, its sources, and where it goes to, what means do you employ?

A. I am using geophysical, geological, geochemical, and hydrological means.

Q. Would you start with the first one, and tell me what that is, Doctor, and what your training has been with respect to that?

A. Geophysical means are used to determine the different physical properties of the rocks and the underground water conditions, such as electrical means, which shows the conductivity, or the reverse means the resistivity of the ground.

Q. That means the resistance of the ground?

A. The resistance of the ground, of the body that is three-dimensional shaped, is not called resistance, but resistivity.

Q. I don't know very much about that, I know, Doctor. Would you tell me a little bit more how that works, and whether or not it is a generally accepted method?

A. This is a generally accepted method and [36] this is one of the papers of the Department of Interior, United States Bureau of Mines, Circular No. IC6899, Geophysical Prospecting of Underground Water in Desert Areas, by F. W. Lee.

Q. This geophysical method of prospecting has been used by the Department of the Interior for how long?

(Testimony of Heinrich J. Thiele.)

A. This has been used since the last thirty years.

Q. Do other industries use it also?

A. Yes, sir. It is used chiefly in the oil industry for determining the different strata in a bore hole. When you are boring down a bore hole, it means you don't core samples any more. You have to determine the different character of the different sediments with geophysical means, and this is the same procedure as is used, electrical procedure, to determine what kind of material is in the bore hole encountered, and even it is determined with electrical means, the permeability, and the amount of oil that can be found.

Q. Can you tell me, Doctor, the next scientific approach that you brought to a study of this problem? You said geophysical. What was the next?

A. By geological means.

Q. By geological, you mean what? [37]

A. The general geology of the country, the structural trends.

Q. Has that been a portion of your education, Doctor, the study of geology? A. It has.

Q. Following the geological study, what did you do?

A. After the geological study, I made a general hydrological study.

Q. That means what?

A. About the water flow in the streams, the rainfall, evaporation.

Q. You studied the records with respect to weather?

(Testimony of Heinrich J. Thiele.)

A. I studied records of the U. S. Weather Bureau and the Geological Survey with respect to the underground water conditions, the surface water conditions of this area, not to forget the records of the U. S. Department of the Interior, Bureau of Reclamation, with respect to this area.

Q. With respect to what area?

A. With respect to the Burro Creek area, or the larger area, the Lower Colorado River Basin.

Q. That is a study which has been made by the Reclamation Service of the Lower Colorado Basin, including the Bagdad area, is that correct? [38]

A. That is correct.

Q. From that did you get the records with respect to the average rainfall, the average rate of evaporation, and similar data with respect to the Bagdad area?

A. I did, from these different organizations.

Q. When you started to make this study of the area, what did you first do, Doctor?

A. I first studied the conditions at the known sites where we had test holes and bore holes, and we actually could see the geological conditions, subsurface conditions and depth of the water table.

Q. How did you first see the area?

A. I first saw the area by air.

Q. You flew over it?

A. I flew over it to get a general impression. I have been flying over this area to get a detailed picture three times.

Q. And then after you had done that, you got

(Testimony of Heinrich J. Thiele.)

the general geological, topographical view of the matter, then you made a study of known data on the ground, is that right? A. I did.

Q. Which included what?

A. It included the testing of boring cores, cores that had been run by test drilling. [39]

Q. And where did you examine those?

A. I examined those in the Burro Creek valley.

Q. And did you make any examination with respect to the standing water table in the valley?

A. Yes, I took a look in different well sites to find out the depth to the water table.

Q. Then after you had made a general observation, did you then proceed to detailed examination?

A. I went into detailed examinations and started with the geophysical survey.

Q. Doctor, could you, in your aerial survey, and in your ground examination of the place, could you determine a mountain range, or what appeared to be a mountain range and its course?

A. Yes, I can.

Q. Where does that lie with respect to Burro Creek and the Bagdad point of diversion?

A. If I may explain on the exhibit?

Q. Yes.

The Court: We will have our morning recess.

(Recess.)

The Court: You may proceed.

Q. (By Mr. Wilmer): Doctor, I believe you stated you had prepared a textbook?

(Testimony of Heinrich J. Thiele.)

A. Yes, sir. [40]

Q. What is the name of that?

A. Ground Water Exploration. And I have written the second part of this book, Geolectrics in Ground Water Exploration, published by the German Association of Gas and Water Works.

Q. These various papers you have handed me are some of the additional papers which have been prepared, which you have had published, is that correct?

A. Yes. And this is a copy of my diploma for Doctor's degree, dealing with the same type of work.

Q. What you are referring to is this?

A. My doctor's thesis.

Q. Would you mind reading that, so I would know what it says?

A. It says I received my doctor's degree for a dissertation dealing with Geoelectrics in Ground Water Exploration, and an additional paper on Ground Water Hydrology and water supply of der flandrischen/Nordseemarschen, of the northern parts of Belgium and the Netherlands.

Mr. Wilmer: Would you mark those for identification.

The Clerk: Defendant's Exhibit P for identification. [41]

(Said documents were marked as Defendant's Exhibit P for identification.)

Q. (By Mr. Wilmer): Going back just a min-

(Testimony of Heinrich J. Thiele.)
ute, Doctor, on the geology of this situation. Generally speaking, can you tell whether the mountain range which lies to the, I believe you said to the—maybe you better say. Have you prepared a diagram?

A. I have prepared a rough sketch showing the trend of the mountain range from the Big—from the Aquarius Mountains, the Grayback Mountains, the Miller Mountains, and Big Ship Mountains. It is the mountain range extending from north northeast to south southwest.

Mr. Wilmer: May I have this marked for identification?

The Clerk: Defendant's Exhibit Q for identification.

(Said document was marked Defendant's Exhibit Q for identification.)

Mr. Wilmer: So the court and counsel can see what you are doing, Doctor, I will put this on the board.

Q. (By Mr. Wilmer): Now, Doctor, would you explain the diagram you have prepared, and identify first all the various [42] points?

Mr. Morgan: We object to that unless it has been offered in evidence.

The Court: We can use it until Mr. Fletcher testifies. Go ahead.

The Witness: We have here Boulder Creek going here from the north, flowing in a western direcrection, and joining Burro Creek. Burro Creek is

(Testimony of Heinrich J. Thiele.)

flowing here through a basin that has been determined already before, and flowing into the mountain range that is noted in brown color on this sheet. (Indicating.)

Q. (By Mr. Wilmer): Will you tell me for the purpose of the record, Doctor, do the streams on there have the appropriate names on them?

A. Yes, sir.

Q. They show Boulder Creek and Burro Creek written on the map?

A. Boulder Creek and Burro Creek are written on it.

Q. Now, the brown chalk, or brown crayon trend that you have shown there, what does that represent?

A. This trend represents a mountain range consisting of different types of igneous rock, such [43] as granites, diorite, gneiss, and schist.

Q. You have indicated in pink, or red color, a basin?

A. This is a little basin, the Burro Creek Basin that has been shown already in Exhibit No. M or N.

Q. That is the one Mr. Colville testified to surveying, is that correct?

A. Yes. The lower part of it has been surveyed.

Q. Will you tell me, Doctor, if at about the point where Burro Creek enters the mountain range, that is where the rock comes out?

A. Here comes the bedrock out.

Q. And from that point on down, is it pretty generally bedrock?

(Testimony of Heinrich J. Thiele.)

A. Bedrock overlain by gravels.

Q. And you made an examination to determine the average depth of those gravels, did you?

A. I did.

Q. Did you make an examination to determine the average distance of the alluvial deposits in the basin that you have shown there in red?

A. I did.

Q. Now, Doctor, can you tell, geologically speaking, whether that mountain range is rising or [44] sinking?

A. This mountain range is rising. You will find everywhere along the walls of the canyons large boulders at a height of a hundred feet and above.

Q. Without attempting to explain why, is that generally accepted geologically as a fact that that particular area is rising rather than sinking?

A. It is generally accepted that we still have movements all over the state today.

Q. Now, with respect to the surveys of the ground there, Doctor, can you by visual examination determine an old channel which at one time probably represented the course of Burro Creek?

A. Yes, you can from the air, because you can see very easily outcropping bedrock. On the other side of this basin again you see bedrock cropping out in the river bed.

Q. Now, you are pointing down to a point at approximately the Bagdad point of diversion?

A. Yes, near the Bagdad point of diversion.

Q. Above that?

(Testimony of Heinrich J. Thiele.)

A. Yes, above it we have bedrock. Distinctly at the Bagdad point of diversion bedrock is cropping out.

Q. Then do I understand from the Bagdad point of diversion to the north and northeast you [45] see bedrock and mountains?

A. Bedrock overlain by cemented material.

Q. Then at approximately the Kingman Crossing, you again see the outcropping of bedrock?

A. Yes, right here.

Q. Can you also see where the old channel of the Burro Creek lays to the direction which it formerly took?

A. Yes, it took this former direction. (Indicating.)

Q. How do you determine that, Doctor?

A. You can see it from the air. We determined it by geophysical measurements, in establishing the depth of bedrock, and, on the other hand, flying over the area to get a view of this old channel.

Q. You say you made certain geophysical examinations to determine the depth of the bedrock. I think it might be helpful at this point, Doctor, if you tell us how that is done?

A. Well, this is the ground surface. And when you take a battery in this circuit, an amperemeter, and send the current into the ground, you get a closed circuit. (Illustrating on blackboard.) And the penetration depth of the current is determined by the distance between these two stakes. [46]

Q. Let me stop just a minute, Doctor, because

(Testimony of Heinrich J. Thiele.)

this is going in the record, and it is a little indefinite.

You have shown a ground surface?

A. Yes.

Q. And you have shown two lines that you have indicated? A. Two electrodes.

Q. Those are electrodes; are they?

A. Yes, electrodes.

Q. And they are set into the ground. How far are they set in? A. Set into the ground?

Q. How far? A. To a depth of one foot.

Q. A depth of one foot? A. Yes, sir.

Q. And how far apart are those electrodes that are set in the ground?

A. We are starting with a distance of about six feet on each side.

Q. On each side of what, now?

A. Of the center stake.

Q. And the center stake is what?

A. I am sitting here with my instrument.

Q. And what is your instrument? [47]

A. My instrument is an electrical compensator, to compensate a potential of an electrical current that is in the ground, against the potential of batteries that you have in the instrument.

Q. What is the source of the electrical current that you use to put into the ground?

A. The source is electricity in batteries.

Q. It is a field geophysical plant, is that right?

A. Yes.

Q. Can you tell us a little bit how you determine

(Testimony of Heinrich J. Thiele.)

when the depth at which it is to bedrock by that method?

A. Yes. Assume that you have two different layers in the ground, this gravel here, underlain by bedrock. (Indicating on diagram.)

When you start with an electrical measurement, with a small distance like this, your current is flowing to this depth here, and when you plot now the actual electrical values in this material against the depths—this is the depth, this is the resistivity (indicating) you get for this distance one point of the resistivity curve.

Say, this is one hundred ohmmeters. An ohmmeter is the generally acknowledged unit of the resistivity. Two hundred, [48] three hundred, you get for this distance, for this depth, now, at one point, and you increase the depths and you get another point. That stays at the same value. Of course, so long as you are staying in the same material.

Now, then, when you come with your current into this second layer, let us assume they have lower resitivity, your values will decrease. And with this increase in depth you come to the true value of this material and receive the resistivity.

Q. You said you come to the true value of the raw material?

A. The true value of the raw material.

Q. The true characteristic of this material?

A. The true characteristic of this material. Assume we have here a characteristic of 300 ohmmeters, and we have here a characteristic of ten ohmmeters.

(Testimony of Heinrich J. Thiele.)

Then you receive this curve that is ending practically in ten ohmmeters, ten ohmmeters here. For the interpretation of this boundary there exists certain standard curves, curves that have been calculated with the differential analyzer, and standard mathematical and physical interpretations, and you can determine with the help of these curves this boundary here, and the exact value of the resistivity of the lower layer. [49]

Q. May I ask you this, Doctor, because I am afraid I don't understand what you said.

In the use of this geophysical method of determining depths to underground bedrock, such as, we will say, for dam footings? A. Yes.

Q. And similar uses. Has the practical value been determined through actual excavation and a finding that the geophysical determination was accurate?

A. Yes, it has.

Q. In other words, may I ask you this, Doctor? What is the percentage of error, if you know, with respect to the use of this scientific method of determining depths to bedrock? A. Ten per cent.

Q. That lies within the 10 per cent of error?

A. Yes, sir.

Q. If you gauge it at 100, it could be 90 or 110?

A. Yes.

Q. Is that a scientifically accepted fact?

A. That is scientifically accepted.

Q. All right, you might sit down, if you wish, Doctor.

With respect to the channel which Mr. Colville

(Testimony of Heinrich J. Thiele.)

testified to, or, rather, the basin— [50] could I have that Exhibit N.

I am referring to Defendant's Exhibit N in evidence. When did you begin your examination of this area, Doctor?

A. I started with my examination February 18th.

Q. Of this year? A. Of this year.

Q. And how much time have you devoted to it since that time? A. Up to this day.

Q. How much time did you spend actually in the field making measurements and examinations?

A. Two-thirds of the time.

Q. Two-thirds of that time? A. Yes.

Q. Is that correct? A. That is correct.

Q. So you have spent, this being the 10th I believe, you have spent approximately 18 days in the field? A. I can give you the exact data.

Q. It isn't important, Doctor. Approximately two weeks, or that? A. About two weeks.

Q. And that is actual field work, is that [51] correct? A. Actual field work.

Q. How many people did you have assisting you?

A. Changing with the time, between four and six.

Q. And what was the purpose of having that number helping you?

A. These people had to place the stakes into the ground, the electrodes into the ground with the changing distance, where I received the changing depths.

A. As I understand it, you start with the two elec-

(Testimony of Heinrich J. Thiele.)

trodes a given distance from your central station where you have your instrument?

A. Yes. And I am picking up to complete the picture. I have here the setup where I have a Wheatstone Bridge arrangement. (Indicating on diagram.)

Q. The what?

A. Wheatstone Bridge arrangement.

Q. That is the Wheatstone Bridge?

A. Wheatstone Bridge.

Q. Now, that is the instrument that you use in your calculation?

A. Yes, that is the physical setup.

Q. And then you move these electrodes [52] out—— A. Out to a greater distance.

Q. How many times will you move the electrodes to make a reading at a given point, or is there any specific number?

A. You measure to a depth of 3,000 feet, and you have to move these electrodes 30 times.

Q. Now, how many different stations, Doctor, did you take these readings at?

A. Sixty-five stations.

Q. Now, does that include the entire distance from the Bagdad diversion point down to the Zannaras millsite? A. It does.

Q. Now, before I forget it, I want to ask you one other question which I didn't ask in relation to this exhibit, which is Q for identification. I will offer it in a minute.

Can you tell me, Doctor, if at the lowest point of the Burro Creek basin, as it is marked on here, that

(Testimony of Heinrich J. Thiele.)

is, where it enters the red, if at that point the old channel turns and goes along the northwest side of the brown area which you have indicated as constituting generally the mountain range?

A. Yes, it does. It enters the mountain range there. [53]

Q. I am speaking now of the old channel which you testified that you could see from the air, which you have indicated by a blue arrow pointing to the southwest? A. Yes.

Q. Beyond this point here, does that channel go into the mountains, or does it go along the northwest side of the mountains?

A. Along the northwest side of the mountains.

Q. Now, Doctor, in the study which you made, then, I take it that you calculated, determined the depth of the basin from the Bagdad sump to the Kingman Crossing, roughly, which I am going to refer to as the bottom of the basin, and then you also calculated the average depth of the materials from the Kingman Crossing to the Zannaras mill?

A. I did.

Q. Was Mr. Colville working there during the time you were there?

A. Mr. Colville was working at the time when I was there.

Q. As a matter of fact, he helped you in some of your work, is that right? A. He did.

Q. In establishing stations?

A. He did. [54]

Q. Doctor, did you then determine the depth of

(Testimony of Heinrich J. Thiele.)

material in the basin above the Kingman Crossing with sufficient accuracy that you could plot it on a map or a graph to show it? A. I did.

Q. Is that true also of the material in the depth lying below the Kingman Crossing to the Zannaras mill? A. That is true.

Q. And did you prepare such a plat?

A. I prepared such a plat.

Mr. Wilmer: May this be marked as Defendant's Exhibit R.

The Clerk: Defendant's Exhibit R for identification.

(Said document was marked as Defendant's Exhibit R for identification.)

Mr. Wilmer: I will put this on the blackboard.

Q. (By Mr. Wilmer): Referring to Defendant's Exhibit R for identification, if you were to take a knife and cut down the center line, if you could do that, of Burro Creek from the Bagdad diversion point, which is at point B, as shown on the upper righthand corner of the map, to the Zannaras pump, is that generally what you would see with respect to [55] overlaying of gravels, alluvial materials and bedrock? A. It is.

Q. Is this area which you have colored in blue the old valley that you have referred to?

A. This is the old valley I referred to. The brown color represents the bedrock. The surface contours of this cross-section are related to the level, or approximately to the level of the Burro Creek.

Q. I see you have noted on here the Old King-

(Testimony of Heinrich J. Thiele.)

man Crossing? A. Yes, sir.

Q. That is approximately where the water rises and gets into bedrock again, doesn't it?

A. Yes, it does.

Q. In addition to the soundings, or the geophysical examination which you made in the actual bed of Burro Creek, did you make any examinations to determine in this area here whether in fact there did exist an old channel here? A. I did.

Q. Where did you make the soundings in these examinations?

A. These points are given in this chart here, numbers 13, 14, 15, 16, 17 G_1, D_7, 6, and 5. (Indicating.) [56]

Q. I see. Did you go outside the basin to see if the channel extended in that direction?

A. I did on the other side here.

Q. And what did you determine?

A. We found the basin with a depth of bedrock at approximately 1,200 feet above sea level.

Q. And how does that compare with the basin there?

A. It compares completely. We have the same depth.

Q. That was made lying up on the——

A. On the mesa.

Q. And does that generally conform with what you see from the air as an old channel sweeping through there? A. It does.

Q. And what is the geological explanation of that?

(Testimony of Heinrich J. Thiele.)

A. Older sediments have been settling down on top of the bedrock. The age is not determined of these sediments, but it is published in the paper of the office of the Arizona State Water Commission, "Ground Water Resources of the Big Sandy Valley, Mohave County, Arizona," by Roger B. Morrison, December, 1940.

This material has been determined [57] in the Big Sandy Valley.

Q. In other words, then, Big Sandy lies about four or five miles beyond this point?

A. Yes, sir. And we see this material on top of the mountain range at certain places, and also on the other side of Big Sandy, and it has been determined here as older fill.

"The older valley-fill deposits directly overlie the basement rocks and earlier volcanics. They consist of two principal members of similar age, which grade laterally from one into the other. Exposed near the highlands is the fanglomerate-breccia member, and indistinctly stratified piedmont deposit which includes more or less angular fragments of all sizes. It is so poorly sorted that it locally resembles a glacial till. This member grades laterally toward the interior of the valley from coarse to finer-sized material and into lake beds."

The same as we observe here, the same we observe here, where it is running off as a lake bed deposit.

"The latter are chiefly silt, fine silty sandstone, and clay, laid down while the Big Sandy River was temporarily dammed [58] by faulting and thus formed lakes within the several basins. In some

(Testimony of Heinrich J. Thiele.)

places there are beds of concretionary limestone, volcanic ash, gypsum, analcite sandstone, diatomite, and bentonite. Along the eastern margin of Wickiup Basin the lake beds are locally interbedded with basaltic lavas. Here the lake beds are also in many places deformed by small closely-spaced faults. Because the faults are normal and nearly all dip westward the aggregate effects of the faulting have unquestionably been large, for the displacements were cumulative and involved successive downdrops to the west."

Q. Doctor, is it your opinion that at some time, you don't know how long ago, that the course of the Burro Creek, instead of going through the mountains where it now goes, followed a course on the north and west of the mountain range, and into the Big Sandy, and in that fashion?

A. It is.

Q. Let me ask you this, Doctor. The old channel which follows along to the north and west of the mountain range, unless it were of a different material, then your alluvials in here would unquestionably carry off a substantial part of the [59] water underground, would it not?

A. That is right.

Q. Because it would be coming up against a bedrock dam, so to speak, which is evidenced at that point?

A. We have practically an underground dam site that acts for the ground water as the underground dam at this point. The older material, it is

(Testimony of Heinrich J. Thiele.)
said in this same paper here, at page 3, and I will read it:

"Both members of the older fill are relatively impervious. No well-sorted 'clean' beds of sand or gravel which would make good aquifers were seen in either the fanglomerate-breccia or the lake beds. In a few places wells have obtained water from the fanglomerate-breccia, but the capacities of nearly all of these wells are relatively small."

It shows we have a certain permeability. It is not impervious, but water can seep through the gravels into this material at certain places.

Q. In effect, you have at the point of the Kingman Crossing, and extending across the present channel of Burro Creek a stone dam, do you not?

A. Yes.

Q. Which extends in a southerly direction [60] —which extends in a southwesterly direction at the base of the mountain range there?

A. Yes, at the base of the mountain range.

Q. Now, Doctor, to clarify the record. There appears a legend on that exhibit with a yellow color, a blue color, and a brown color. Do those colors accurately reflect your determinations as to the type of material that would be found, as shown in the colors on the exhibit?

A. It does. They determine the thickness and the type of the material. The yellow color represents Boulders and Gravels that have been found between Kingman Crossing and Zannaras pump in the thickness of 37 feet, 35 feet, 7 feet, 13 feet, 6 feet, 28 feet, 7.5 feet, 19 feet, and 7 feet.

(Testimony of Heinrich J. Thiele.)

Q. That is between——

A. That is between the Old Kingman Crossing and Zannaras pump.

Q. Now, that is the overlay of sand and boulders and gravels above the Kingman Crossing and up to the Bagdad pump?

A. Above the crossing and it is mounting up to 40 feet, the thickness of the gravel area.

Q. And is that the average depth, or does it vary from place to place?

A. It is also changing in the outcroppings [61] from a few feet or none at all, up to a thickness of 40 feet.

Q. That is the overlay of sand and gravels above the alluvial materials below it?

A. Above the older fanglomerate that is colored blue in this chart.

Q. That is a sedimentary deposit of some kind?

A. We don't know if it is alluvial. We don't know anything about the age. The thickness of this deposit is about 1,200 feet.

Q. That is 1,200 feet of blue? A. Yes.

Q. At the depth of the basin it is 1,200 feet deep?

A. The depth of the older valley that is crossing today's valley is 1,200 feet deep in the center.

Q. In the center. And then it shades out as you have shown it, to the edge? A. Yes, sir.

Q. In other words, if I may express it this way: The Bagdad pump and sump is at one side of the valley, and the Kingman Crossing is at the opposite side of the valley? A. It is. [62]

(Testimony of Heinrich J. Thiele.)

Q. And the valley extends in a northeasterly southwesterly direction? A. Yes.

Q. And the Burro Creek flows across it at an angle?

A. Yes, sir. But we can see on this chart here that the general trend of the flow of conditions have changed locally, but not in the general direction. We see the same direction in the flow of the river, the creek flow from the northeast to the southwest.

Q. And does that exhibit, which is R, Defendant's Exhibit R, accurately represent, Doctor, your scientific findings with respect to the conditions existing from the Bagdad sump down to the Zannaras property?

A. The cross-section represents accurately my findings.

Q. From the standpoint of viewing the surface itself, from the Kingman Crossing to Zannaras Mill, do your observations on the surface confirm your geophysical findings? A. They do.

Q. And tell us why.

A. You see the outcropping bedrock as well in these areas, as well as up here in this area. [63] (Indicating on chart.) We see bedrock coming out here and here along this other side of the valley, and this side of the old valley.

In between we find only the fanglomerate-breccia with its different members, limestones, sandstones, and cemented areas.

Q. Would this be a fair statement, Doctor, that as you come to the lip of the valley, in other words, as you go along this area following the edge of the

(Testimony of Heinrich J. Thiele.)

channel on each side of the edge of the basin, you find outcroppings in the type of materials you would expect because of your geophysical findings?

A. Yes, sir. And the differences of the resistivity values that I explained here are remarkable. We have gravel, the top gravel sheet has a resistivity of 200 to 600 ohmmeters.

The fanglomerate-breccia is recognized by resistivities of 10 and 30 ohmmeters. And the bedrock underneath has a resistivity of more than 100 ohmmeters, again, so there are remarkable differences in the physical characteristics of the different formations.

Q. Did you make a calculation and examination, Doctor, at the point of Burro Creek approximately opposite the Zannaras mill and pump to [64] determine the depth of the gravels and similar materials above bedrock across the creek channel at that point?

A. Yes; I made several determinations, and we found a thickness of the gravel sheet changing between 7 and 37 feet.

Q. Now, to be sure we have the record straight, Doctor, I am referring to the creek bed at the Zannaras mill.

Approximately how wide is the channel of the creek at that point, if you recall, or could you tell from the scale on that chart there?

A. It is widening out here to about 500 feet (indicating on chart). The normal width of the valley is between 200 and 300 feet.

(Testimony of Heinrich J. Thiele.)

Q. And that is mostly surrounded by bedrock, with bedrock outcroppings?

A. Yes. The average width of the valley is 215 feet, as an average taken out of thirty stations.

Q. And at the point where the Zannaras pump is in the creek, from bank to bank of the stream there you found a difference of from 7 feet to 40 feet of gravels, did you?

A. Yes, and bedrock at some places—at this station, at this edge of this side, bedrock crops out directly.

Q. At the site where the pump is? [65]

A. Yes.

Q. Then across where the other——

A. Bedrock dips in and comes out the other side again.

Q. I didn't quite understand, myself, I guess. The bedrock crops out, or there is bedrock showing on the east bank of the channel at the Zannaras pump? A. Yes, sir.

Q. Then from that point across to the opposite bank, what type of material is there in the creek bed? A. We have gravel in the creek bed.

Q. And did I understand you to say the depth was from 7 to 40 feet? A. To 37 feet.

Q. So that you do have in the creek bed at that point gravels up to 37 feet in depth?

A. Yes. The point where we have 37 feet is about 300 feet north.

Q. Of the pump? A. Of the pump.

Q. Now, Doctor, is there a known method of

(Testimony of Heinrich J. Thiele.)

calculating the amount of water which will move underground, if you know the materials through which it is moving? [66] A. There is.

Q. Are there handbooks that are used in connection with determining the—what did you call it, of the ground?

A. The permeability of the ground.

The Court: We will go into that after lunch. We will suspend at this time until 2:00 o'clock.

(Thereupon, at 12:00 o'clock noon a recess was taken until 2:00 o'clock p.m. of the same day.) [67]

Tuesday, March 8, 1954—2:00 o'Clock P.M.

(Hearing resumed pursuant to recess.)

The Court: You may proceed.

HEINRICH J. THIELE

resumed the stand and testified further as follows:

Direct Examination
(Continued)

By Mr. Wilmer:

Q. Before going back to where we quit before the noon recess, Doctor, have you done any lecturing or teaching in this country?

A. I have been lecturing in ground water courses of the U. S. Geological Survey in Austin, Texas, in the University of Texas.

(Testimony of Heinrich J. Thiele.)

Q. At the University of Texas? [68]

A. Yes. In March, 1953.

Q. Now, Doctor, coming back to this point where we left off, with respect to a stream such as Burro Creek, where you have surface flow, and also gravels and sands, we use the term surface water and ground water. Actually, in a stream such as that, is there any difference between the surface flow and the ground flow, or are they just one body of water?

A. No; there is no difference. I am reading something out of this report I mentioned already, on the Water Supply of the Lower Colorado River Basin, as given on page 67:

"In the hydrologic cycle, there is a close interrelationship between surface water and ground water. In some areas ground water contributes to the flow of the streams, whereas, in other areas the streams feed the ground water. For example: When water percolating through the soils and rocks reaches an impermeable layer of saturation, it moves laterally under the force of gravity until it is stored in a confined area, or emerges as springs or seeps where the water table intersects the land surface and contributes to the streams." [69]

Q. Now, I started to ask you before, Doctor, with respect to the permeability of materials, and whether or not there is a handbook with relationship to an established and accepted standard of the amount of water which can be found in various types of ground strata?

(Testimony of Heinrich J. Thiele.)

A. There is a handbook.

Q. What is that handbook?

A. This handbook is "Methods for Determining Permeability of Water-bearing Materials, With Special Reference to Discharging Well Methods," U. S. Geological Survey paper, Supply paper 887, Washington, 1942, by L. K. Wenzel and V. C. Fishel.

Q. Are the tables contained in that customarily used in determining the amount of water which will be found in different types of gravels and materials?

A. Yes. The methods applied in this book are the standard methods, and the tables are the best tables available for comparative, or comparing purposes.

Q. Would you turn to the table with respect to the permeability of gravels and sands, if you have such a table?

A. Yes; here is a table on page 13, Physical Properties of Representative Materials from [70] the United States. And in this table on pages 13 and 14 are given for gravel, sand and gravel, coefficients of permeability from one thousand to 90 thousand gallons per day per square foot.

Q. Now, Doctor, I don't quite follow that. Would you tell me, if you would, the practical application of that with respect to any studies of sand and gravel, and as to the amount of water either found in them or yielded by them, or traversing them?

(Testimony of Heinrich J. Thiele.)

A. Yes. I am going to read something from page 7 about the coefficient of permeability, to give a clear picture of this:

"The two coefficients of permeability are used by the division of ground water of Geological Survey. One coefficient is defined by Meinzer as the rate of flow of water, in gallons a day, through a cross-sectional area of one square foot under a hydraulic gradient of 100 per cent at a temperature of 60 degrees Fahrenheit. This coefficient may be expressed in field terms as the number of gallons of water that would be conducted, were the temperature of the water 60 degrees Fahrenheit, through each mile of water-bearing bed [71] under investigation (measured at right angles to the direction of flow) for each foot of thickness of the bed, and for each foot per mile of hydraulic gradient."

That means when you want to determine the amount of flow in the underground, you have the coefficient of permeability, times the slope of the water table measured in feet per mile, times the thickness, as I say, the square section of the aggregate.

Q. The square section of the aggregate?

A. The square section of the aggregate of the aquifer of the water-bearing material. This is the term in square foot.

Let us assume a case as we have it up here at the pump station of the Bagdad Copper Corporation. It really has a width of 200 feet, and the thickness of the aquifer is about 15 feet. The test hole there

(Testimony of Heinrich J. Thiele.)
in the center of the stream, of the creek showed a thickness of the gravel material of 15 feet. Bedrock was not encountered yet. But bedrock was coming out of this side, just dipping into the other side.

Let us assume 15 feet——

Q. Before we go further, Doctor, from your examination of the particular area now, which [72] is, I believe, right at the sump of Bagdad?

A. Yes.

Q. From your examination of the stream bed and this test hole that was drilled, and the other examinations you made there, in your judgment is 15 feet a fair average of the overlay of sand and gravel in that area?

A. It is. Because they have outcropping of sand and rock on one side.

Q. That is 215 feet wide, by 15 feet of material above bedrock?

A. That is right. Now, we have the permeability factor between one thousand and 90 thousand. We don't know anything exactly.

Let us take a fair value. That would be 10 thousand gallons per day per square foot.

Q. You say that permeability factor ranges from one thousand gallons to 90 thousand?

A. To 90 thousand.

Q. And you have taken a very low factor of 10 thousand? A. Yes.

Q. All right.

A. The slope of the water table is about—is 185

(Testimony of Heinrich J. Thiele.)

feet in three miles. We determined it in the basin there. [73]

Q. That was the basis of the survey made by Mr. Colville?

A. Yes, sir. That would make it 60 feet in a mile. It would be a little bit more than one in a hundred. Let us assume one in a hundred.

Then we have here now 300,000 gallons per day per square foot. When we want to put that in acre feet, we have to divide it by 342 thousand.

Let us be fair again. Let us call the whole thing one acre foot a day as the amount of water that is traversing the cross-section of the area at the Bagdad Copper plant. In the Burro Creek Valley——

Q. Let me interrupt you again, Doctor. In other words, if I understand this correctly, based upon your determination of the width of the creek bed, your determination of the depth of the material, and the type of material that it is, you determine that the normal underground flow at that point would be an acre foot a day, or 342,000 gallons of water per day? A. Yes, sir.

Q. That is correct? A. Yes.

Q. Now, what would be the effect, Doctor, if you assumed, instead of the 10 thousand gallon [74] permeability factor, one thousand gallons. That would be one-tenth of that, isn't that right?

A. It would be only one-tenth of that.

Q. And if you assume 90 thousand, it would be nine times that? A. Yes, sir.

(Testimony of Heinrich J. Thiele.)

Q. So that at the lowest computation, you would have one-tenth of an acre foot per day?

A. On your one thousand.

Q. On your one thousand?

A. That is correct.

Q. And on your highest computation, you would have nine acre feet per day? A. Right.

Q. And there are 342,000 gallons in an acre foot? A. Yes.

Q. Now, Doctor, did you make some studies of the U. S. Geological Service records, of which I believe you have a publication with you, involving the average evaporation rates in various parts?

A. Yes. Better than that, we have a table of the evaporation rates of the lower Colorado River basin, in the report mentioned already, on page 27, Table I.

Q. And that gives the average evaporation [75] rates in various sections of the country through each month in the year, is that correct?

A. Yes.

Lower Colorado River Basin, Estimates of Average Evaporation in Inches at Supplemental Stations from 1914 to 1945 period. Station, Bagdad.

The evaporation figures are: January, 1.9. February, 2.5. March, 4.7. April, 6.8. May, 9.3. June, 11.0. July, 11.1. August, 9.5. September, 7.7. October, 5.6. November, 3.1. December, 1.8. Giving an annual total of 75.0 inches.

Q. Now, as I understand that, Doctor, that means that on the average, in the average year at

(Testimony of Heinrich J. Thiele.)

Bagdad, there is a water loss of six to seven feet, or 75 inches?

A. Yes. On the open water surfaces.

Q. From an open water supply? A. Yes.

Q. And that the highest evaporation rate is in May, June, July, and August?

A. The highest evaporation points are in June and July. We have distinctly a curve with the maximum in June and July.

Q. Do you have that exhibit in a certification from the United States Geological Survey of [76] the evaporation rates at Tucson, Roosevelt and Safford?

That is it there?

A. Yes. (Handing document to counsel.)

Mr. Wilmer: I would like at this time, if it please the court, to offer in evidence a certification of the U. S. Weather Bureau at Phoenix, Arizona, showing the amounts of precipitation at Bagdad, Arizona, during the months and years, as follows: From 1940 through 1953, showing the total annual precipitation, and also showing the mean monthly annual evaporation in inches at the stations of the U. S. Weather Bureau at Roosevelt, Safford, and Tucson, and showing the relative elevations of those three points.

Mr. Morgan: No objection.

The Clerk: Defendant's Exhibit S in evidence.

(Said document was received in evidence and marked as Defendant's Exhibit S.)

DEFENDANT'S EXHIBIT S

United States of America

United States Department of Commerce
Weather Bureau

Station: Phoenix, Arizona. Date: March 3, 1954.

As the custodian of the records of the U. S. Weather Bureau, filed at Phoenix, Arizona, I hereby certify that it appears from such records that the following amounts of precipitation occurred at Bagdad, Arizona, during the months and years as shown:

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1940	1.05	1.93	0.19	0.84	T	0.14	T	0.69	3.90	1.24	1.37	2.49	13.84
1941	2.30	2.90	4.56	3.47	0.20	0.03	2.05	2.05	3.36	1.79	0.57	2.26	25.54
1942	0.44	0.93	0.52	1.28	0	0	1.83	1.21	0	0.19	0.21	0.71	7.32
1943	2.03	0.69	1.23	0.92	0	0	0.51	1.63	2.26	1.28	0	1.21	11.76
1944	0.55	6.28	1.36	0.81	0.05	0	0.03	1.04	1.36	0.76	2.32	1.95	16.51
1945	1.23	0.18	5.33	T	0	0	0.79	2.57	0.02	1.91	0	2.35	14.38
1946	0.60	0.05	1.45	1.29	0.07	T	4.16	1.29	1.61	1.75	1.78	2.02	16.07
1947	0.37	0.11	T	T	0.32	0	0.30	3.80	0.47	0.34	0.26	1.95	7.92
1948	0	0.85	0.72	0.25	0	0.10	2.73	1.03	0.09	0.87	0	2.58	9.22
1949	4.81	0.53	0.13	0.64	0.05	0.60	1.21	0.44	1.60	1.29	0.61	1.21	13.12

Defendant's Exhibit S—(Continued)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1950	0.77	1.14	0.28	0.19	T	0	3.99	0.19	0.69	0	0.15	0	7.40
1951	1.87	0.67	0.28	3.36	1.42	0	1.15	8.07	0.65	1.77	1.03	1.78	22.05
1952	1.34	0.25	4.23	1.26	0	3.00	0.41	1.00	0.70	0	2.19	0.74	15.12
1953	0.50	0.75	0.15	1.63	0.20	0	1.70	2.24	0	0.04	0.35	0.04	7.60

Mean Monthly and Annual Evaporation (Inches)

Roosevelt	1.83	2.66	4.90	7.16	10.42	12.25	12.28	10.26	8.10	5.33	2.87	1.81	79.87
Safford	1.99	3.35	5.32	7.68	9.84	10.90	9.82	8.27	6.47	4.40	2.78	1.89	72.71
Tucson	2.32	3.09	5.80	8.49	11.22	12.73	11.72	9.38	8.01	5.77	3.33	1.09	82.95

Elevation of Roosevelt .... 2200 Ft.
Elevation of Safford .... 2900 Ft.
Elevation of Tucson .... 2423 Ft.

/s/ LOUIS R. JURWITZ,
Meteorologist in Charge.

Admitted and filed March 9, 1954.

(Testimony of Heinrich J. Thiele.)

Q. (By Mr. Wilmer): Do you know what the approximate elevation of Bagdad is?

A. The approximate elevation of Bagdad is 3,900 feet.

Q. And the Burro Creek is some several hundred feet lower than that? A. 2,400 feet. [77]

Q. 2,400 feet at Burro Creek?

A. In the area of the basin.

Q. Now, for the purpose of showing a table of the evaporation, did you prepare a chart from these certified figures showing the curve of the evaporation at Roosevelt, Tucson, and Safford, with respect to when the evaporation is the highest?

A. Yes. It was done in Bagdad and put on a sheet of paper.

Mr. Wilmer: May this be marked?

The Clerk: Defendant's Exhibit T for identification.

(Said document was marked as Defendant's Exhibit T for identification.)

Q. (By Mr. Wilmer): Referring to this chart, will you tell us just how you prepared it, Dr. Thiele?

A. This chart, the amounts of precipitation are given here in inches per month, January, February, March, and April, and so forth, and it would be easy to show for Bagdad, with 11 inches in June and July, showing the same maximum at the same time of the year——

Q. Doctor, if you would first tell me what these three lines represent?

(Testimony of Heinrich J. Thiele.)

A. These three lines represent the [78] evaporation at Roosevelt, and Tucson, and Safford. Roosevelt elevation, 2,200 feet above sea level; Tucson, 2,423 above sea level; and Safford, 2,900 feet above sea level.

Q. Now, I believe from this exhibit the average monthly, or the average annual evaporation annually at Roosevelt was 79.87 inches; Safford, 72.71 inches, and Tucson, 82.95 inches, as against Bagdad with 75 inches.

Now, for the purpose of illustrating the portion of that water loss that occurs in a year, will you tell us when the greatest percentage of water loss occurs, based upon the record which was introduced in evidence?

A. The greatest loss of water occurs from the months starting April, May, June, July, August, and September.

Q. Now, with respect to——

A. The highest peak is reached in June and July.

Q. And what percentage of the loss, of the total annual loss occurs in that month?

A. In June occur 15.3 per cent at Tucson.

Q. In other words, of your total of 75 inches, 15 per cent of that occurs in that one month alone?

A. Yes. [79]

Q. Did you also have prepared a chart, Doctor, from the U. S. Geological Survey figures, showing the precipitation in the Bagdad area?

A. Yes, sir.

(Testimony of Heinrich J. Thiele.)

Q. With respect to its relationship to normal precipitation for the area? A. Yes.

Mr. Wilmer: We offer in evidence, if it please the court, Defendant's Exhibit T for identification.

Mr. Morgan: We have no objection, although we think it is immaterial.

The Clerk: Defendant's Exhibit T in evidence.

(Said document was received in evidence and marked Defendant's Exhibit T.)

Mr. Wilmer: May this be marked Defendant's Exhibit U for identification?

The Clerk: Defendant's Exhibit U for identification.

(Said document was marked Defendant's Exhibit U for identification.)

Q. (By Mr. Wilmer): I show you Defendant's Exhibit U for identification, Doctor, and ask you if that chart was prepared showing the precipitation in inches——

A. This chart shows——

Q. Just a minute, Doctor. At Bagdad, in [80] the Bagdad area, from 1930 to 1953, with relationship to the normal rainfall, the average rainfall?

A. Yes, sir.

Q. This is a correct chart depiction of the pictures of the U. S. Geological Survey of that area, at that station? A. Yes, sir.

Mr. Wilmer: We offer it in evidence.

Mr. Morgan: All this evidence was put in in

(Testimony of Heinrich J. Thiele.)

this case before. This chart was not, but the evidence was, the rainfall records.

We make no objection.

Mr. Wilmer: It was up through 1951, previously.

The Court: All right, it may be received.

The Clerk: Defendant's Exhibit U in evidence.

(Said document was received in evidence and marked Defendant's Exhibit U.)

Q. (By Mr. Wilmer): Without sticking this up there, Doctor, the figure, which is line 14, represents what? I mean, this line through there represents what?

A. This line represents the long year average from 1930 to 1953.

Q. That is this line through here (indicating)?

A. Yes. Of the whole precipitation. And [81] we see that we have a break between 1945 and 1946. Before 1946 we had most years with more than average rainfall. In the years after 1946 we have mostly years with less than average rainfall.

The actual figures for these years, to repeat that: Before 1946—I am giving the yearly annuals—for 1940, 30.84 inches, in 1940. 25.54 inches in 1941. 7.32 inches in 1942. 11.76 inches in 1943. 1944, 16.1 inches. 1945, 14.38 inches. 1946, 16.07 inches.

And then I have to repeat. I made a mistake. Between 1946 and 1947 comes the break.

Then 1947, 7.92 inches. 1948, 9.22 inches. 1949,

(Testimony of Heinrich J. Thiele.)

12.12 inches. 1950, 7.40 inches. That makes four years of rainfall under the normal.

1951, 22.05 inches. 1952, 15.12 inches. And 1953, 7.60 inches. That makes, in seven years, four years with less than ten inches rainfall.

Mr. Wilmer: May this be marked the next exhibit number?

The Clerk: Defendant's Exhibit V for identification.

(Said document was marked Defendant's Exhibit V for identification.)

Q. (By Mr. Wilmer): Now, Doctor, in the previous hearing a [82] computation of the rainfall data at Bagdad up through 1951 was put in evidence. To bring it up to date, I am going to hand you Defendant's Exhibit V for identification, and ask you if that is a computation brought up through 1953, from the Weather Bureau records?

A. This is a computation of the weather records at Bagdad, furnished through the courtesy of W. D. Deacon, Weather Observer with the Weather Bureau.

Q. That is the gentleman sitting back there?

A. Yes.

Mr. Wilmer: We offer it in evidence.

Mr. Morgan: No objection.

The Clerk: Defendant's Exhibit V in evidence.

(Said document was received in evidence and marked Defendant's Exhibit V.)

(Testimony of Heinrich J. Thiele.)

Mr. Wilmer: I believe there was previously admitted also, if it please the Court, a chart which the U.S.G.S. had prepared, showing the readings at the gauge, that is, if the Court will recall, there was a chart which showed certain readings showing a certain amount of water down the river. We have a copy of that, and since that exhibit, I believe, has gone up—you have that?

The Witness: I have it over there. [83]

Mr. Wilmer: It was the chart that shows a quarter on the gauge means so many gallons down the river. I don't need it at the moment. Here it is here. I think, for the purpose of the record, I should mark these at least for identification, because we will be referring to them.

The Clerk: Defendant's Exhibits W and X for identification.

(Said documents were marked Defendant's Exhibits W and X for identification.)

Q. (By Mr. Wilmer): Doctor, in the computation which you have made, did you make use of the chart of the U.S.G.S. which showed the gauge readings, and the amounts of water reflected on that?

A. I did.

Q. That is Defendant's Exhibit W for identification, is that correct?

A. Yes; that is correct.

Q. And I believe that you also made a computation showing the average flow, of the average gauge readings of the flow in 1953 for the purpose of the

(Testimony of Heinrich J. Thiele.)

computation? A. I did.

Q. That is Defendant's Exhibit X for identification? [84] A. That is right.

Q. Now, with respect to the amount of water which is moving underground in a stream bed, as distinguished from the surface flow, does that vary from time to time, assuming that you have live water in the stream on the surface? The amount of water?

A. No, sir; It depends only on the permeability of the underground, and the permeability of the unconsolidated sediment is not changing.

Q. In other words, the gravels and sands, and other permeable material that constitute your underground, that is full?

A. Yes. And it is for the time of our life, it is practically stable; only with changes in, complete changes in the chemistry of the sediment can we have a change in the permeability of the underground.

Q. That occurs very rarely? A. Yes, sir.

Q. Now, that being true, the rate, or the amount of water which moves downstream in a given stream remains fairly constant from day to day, so long as there is surface water? A. Yes, sir.

Q. Then, Doctor, I take it that it would be [85] your opinion that in the spring and summer months, so long as there is water flowing on the surface, there would be substantially the same amount of underground water moving that there would be when there was a flood going out?

(Testimony of Heinrich J. Thiele.)

A. It is.

Q. Now, you made a calculation, Doctor, I believe, of the amount of water, which you very conservatively computed was moving past the Bagdad sump in the gravels above bedrock, at one acre foot per day? A. Yes, sir.

Q. Did you, with Mr. Fletcher from the Tempe School of Forestry, make a computation with respect to the probable loss of water from evaporation and transpiration from the Bagdad sump down to the Zannaras point of diversion?

A. Yes, sir.

Q. Would you tell us how you went about making that calculation?

A. This calculation was made by Mr. Fletcher based on temperature, rainfall, and different other points he is giving evidence on.

Q. You participated in that study?

A. I did.

Q. Now, briefly, Doctor, from the Bagdad [86] point of diversion down to the Kingman Crossing, is the creek bed pretty generally grown with vegetation?

A. The creek bed is grown with 50 per cent of vegetation.

Q. And what type of vegetation?

A. Mesquite, cottonwoods, black willow, and other types of desert vegetation.

Q. And other types? A. Yes.

Q. Now, the rate of evaporation and transpiration from a creek bed such as this, where you have

(Testimony of Heinrich J. Thiele.)

this type of materials, the relation of that to evaporation from a free water surface, is that something you can tell us about, Doctor?

A. Yes, sir. The evaporation at Bagdad was found to be 75 inches. Bagdad is lying in a higher altitude than Burro Creek, the basin which is on the chart.

Q. Does the altitude have something to do with the rate of evaporation?

A. The altitude, the time of daylight hours, the temperatures have to do with this, and we have a higher evaporation in the lower altitude. It is comparable with Tucson. Tucson, we have 82 inches.

Q. Accepting the Bagdad evaporation rate [87] at 75 inches, because that is substantially higher than Burro Creek, you would expect the evaporation rate to be greater there? A. To increase.

Q. More than 75 inches?

A. More than 75 inches on a free water surface.

Q. Go ahead with the probable water loss in the area below the Bagdad area, in the Zannaras area?

A. The lower part of this basin has nearly all year over water near the surface, or directly at the surface. We have water dammed up at this point here, and causing—with that damming up, that reaches far back to about this area here, and only at this area the water table is deepening and reaches at the Bogle's ranch about 12, 15 feet, average, below the surface.

Q. That is the water table not in the creek bed, but to the side of the creek bed?

(Testimony of Heinrich J. Thiele.)

A. The side of the creek bed. The depth of the water table in this valley, as I have been informed, is not changing much. It shows that though the creek is flowing abundantly and losing water, that you couldn't observe it losing it into the gravel. The water table cannot be built up to the [88] ground surface.

Q. Why is that, Doctor?

A. This is caused by the high evaporation in this area, high evaporation in the whole basin. That is practically a closed basin between these two points.

Q. Can you tell us how the rate of evaporation, including transpiration from the vegetation, relates to the evaporation from an open pan, or free water surface?

A. The evaporation is calculated from different sources differently. The Bureau of Reclamation in Boulder City gives evidence that the estimated ground evaporation in this area is 60 inches in the year. This shows, when we accept again 15 per cent for June of one year, that we would have in one year an evaporation of one foot times 137 acres. That would be 1,374 acre feet in only this basin.

Q. If we accept that figure, that in the month of June you would have 15 per cent of the 60 inches, that would be nine inches, would it?

A. That would be of 60 inches?

Q. Yes. 15 per cent.

A. 15 per cent. No. Yes. Nine inches.

Q. Nine inches, or three-quarters of a foot? [89]

(Testimony of Heinrich J. Thiele.)

A. Three-quarters of a foot. About a thousand acre feet.

Q. So in the month of June, on that basis, Doctor, you would have an over-all evaporation loss of 30 acre feet of——

A. Around one thousand.

Q. A thousand acre feet?

A. That is right.

Q. As against your computation of an input, assuming no surface flow, of 30 acres?

A. 30 acre feet is the surface flow.

Q. However, through the month of June, there is no water passing beyond the sump. You are then losing in that month 970 acre feet out of the basin, net, because you are putting 30 in and losing a thousand, is that right?

A. Yes, sir. I forgot to give the name of the hydrologist of the Reclamation Service in Boulder City. It is Mr. Sullivan, the author of this report. I can give the first names. L. E. Sullivan.

Q. Doctor, may I ask this question: If you compute, instead of 10,000 gallons as a permeability factor, 90,000, there would be that much more water passing by in the gravels at the sump, would there not? [90] A. Yes; there would.

Q. If you took the highest possible amount, you would then have, instead of the one acre foot which you estimated per month, you would have 90 acre feet; if you took the highest possible permeability factor?

A. That would be 270 acre feet a month.

(Testimony of Heinrich J. Thiele.)

Q. I believe you testified you have one acre foot?

A. A day. Is 30 acre feet a month.

Q. Times nine? A. Times nine.

Q. Is 270 acre feet?

A. It can't be so high, because we have granite that is decomposing with the weathering effect. We have building up of clay, and the clay causes a reducing of the permeability.

Q. What I am getting at is this, Doctor: If you take the highest possible permeability factor, which we know can't be true, but still take that, then you have only 270 acre foot input underground, as against a loss of a thousand acre feet in a month?

A. That is correct.

Q. Then if you double the depth of the gravels, which you have given as a generous estimate of 15, and make it 30, you would still simply double [91] your water moving, and get 540 acre feet in a month, against a thousand acre foot loss, is that right?

A. Yes. That means so long as we have no surface flow.

Q. What I am getting at is that when the river reaches a point that the surface flow does not exist, we still are going to say there is from 30 to 270 acre feet passing underground per month. Would that be right?

A. Well, I agree to 30 acre feet. I don't agree to 270 acre feet.

Q. You don't think that is possible?

A. It isn't possible.

(Testimony of Heinrich J. Thiele.)

Q. Now, Doctor, I am going to ask you if you took the U. S. Geological Survey figures from 1902 to 1953, and plotted on Defendant's Exhibit Y for identification the average rainfall, January, February, March, and so forth, August, September, October, November and December, and if that is represented by the brown line which is at the base of that curve? A. Yes, sir.

The Clerk: Defendant's Exhibit Y for identification.

(Said document was marked Defendant's Exhibit Y for identification.) [92]

Q. (By Mr. Wilmer): Then, Doctor, did you also plot on here the curve showing the pan evaporation at Bagdad, so far as the chart was big enough to show it? A. Yes, sir.

Q. Which is represented by a broken red line with the words Pan Evaporation pointed to it?

A. Yes.

Q. Did you then take the figures, Doctor, from the surface flow, the water passing between Bagdad sump from January through December, and plot that on the chart? A. Yes, sir.

Q. That is the——

A. That is the stream flow.

Q. That shows surface flow?

A. The surface flow of the Burro Creek in acre feet per month.

Q. Then did you take your figure as to the subsurface flow, and chart that on there, and indicate that by Subsurface Flow?

(Testimony of Heinrich J. Thiele.)

A. Yes, sir. I added to this some 30 acre feet of subsurface flow per month.

Q. And then did you add to that the amount of water which the record shows Bagdad pumped in that period?

A. I added to this figure the amount of [93] water pumped by the Bagdad Copper Company with 94 acre feet a month, with the exception of June, where there was a shortage of water, only about 70, between 65 and 70 acre feet.

Q. The total of the subsurface flow—the total of the surface and subsurface flow in the Bagdad is indicated by the use of the words Total Discharge?

A. Total discharge in ground water, surface water, and pump water.

Q. Then did you and Mr. Fletcher prepare the blue line on here which shows the probable—which shows the amount of water which would be lost if there was ample water at all times?

A. Yes, sir. This is the evaportranspiration.

Q. Evapotranspiration, that means the combined loss in transpiration by foliage, and by evaporation?

A. By evaporation and transpiration.

Q. You call that generally evapotranspiration?

A. It is the amount of water plotted on the chart as a potential that would be evaporating when it would be there.

Q. May I express it this way, Doctor. That [94] you have termed it potential because in your judgment there is a substantial period of the year when

(Testimony of Heinrich J. Thiele.)
water is not lost through evaporation, because it is not there? A. Yes.

Mr. Wilmer: May the record show I have been referring to Defendant's Exhibit Y for identification.

Q. (By Mr. Wilmer): Now, this dotted red line, Pan Evaporation, which goes up off the chart, and then comes back on the chart, in October, or between August and September that represents the curve of the evaporation with respect to the months of the year?

A. And of an open water surface as we have it in the southern part of the basin.

Q. So that in June the rate has risen so high with respect to the average annual that it leaves the chart, is that right?

A. Yes. The numbers are written on this chart for June.

Q. Now, on this brown line here you have plotted the average rainfall for December, just to show the way the fluctuation occurs? A. Yes.

Q. Now, the subsurface flow which—or the [95] surface flow, rather, which you have testified to, beginning in January at approximately 760 acre feet, is that right? You have your computation?

A. I think I have the computations to give them in detail. I am giving the stream flow in acre feet for the different months of 1953.

Q. Just to have the record clear, Doctor, that is taken computed on the gauge readings, and with the application of the U. S. Geological Survey to

(Testimony of Heinrich J. Thiele.)

that reading? A. It is.

Q. Then you have an average stream flow in January—— A. In January of 763 acre feet.

Q. All right, that falls in February to what?

A. To 597 acre feet.

Q. It raises in March?

A. In March to 662 acre feet.

Q. And April? A. April, 596.

Q. May? A. May, 468.

Q. June? A. June, 196.

Q. July? A. July, 412. [96]

Q. August? A. August, 749.

Q. September? A. September, 282.

Q. October? A. October, 261.

Q. November? A. November, 829.

Q. And December? A. December, 606.

Q. It just follows the stream flow like this? (Indicating on chart.)

A. Yes. I can correct my figure I gave for the discharge by the Bagdad Copper plant in June. It is 69 acre feet in June.

Q. That is the amount taken in June?

A. Taken in June. I gave it between 65 and 70 acre feet.

Q. You have added to your surface flow your estimated underground flow, which remains constant throughout the year? A. Yes, sir.

Q. And therefore follows the green line?

A. The green line.

Q. Then you have added to that the total amount which would be in the river when there were [97]

(Testimony of Heinrich J. Thiele.)

periods of water if Bagdad was not operating at all? A. Yes, sir.

Q. Which would show that in January there would be——

A. 94 acre feet, in addition to the other ones.

Q. Yes. That followed down exactly like this?

A. Yes.

Q. Now, Doctor, the evaporation, or the evapotranspiration curve begins at this point in January, is that correct? A. With 53.8 acre feet.

Q. 53.8 acre feet in the entire basin?

A. In the entire basin, of 14 hundred——

Q. A period of from here down to here? (Indicating on chart.) A. Yes. 1456.5 acres.

Q. In that month it indicates a loss of——

A. 53.3 acre feet.

Q. Which in February rises to——

A. 63.4.

Q. And March? A. 142 acre feet.

Q. In April? A. 260 acre feet. [98]

Q. May? A. 583.

Q. Doctor, at this point here where the blue line crosses the total amount in the river, in other words, at that point in between April and May you have a—— A. A balanced situation.

Q. A balanced situation? A. Yes.

Q. Where there is the stream flow plus Bagdad use, underground and surface equals the——

A. Evapotranspiration.

Q. The loss from evaporation and transpiration?

A. Yes.

(Testimony of Heinrich J. Thiele.)

Q. Now, will you step here to the board, Doctor, and tell me, based on the chart, approximately how many days occur, or pass from the point the ascending curve of the evapotranspiration crosses the total subsurface and surface flow, to the point where it crosses the total flow, including Bagdad; how many days does that indicate?

A. This happens within one or two weeks.

Q. At the most, one or two weeks?

A. Yes, sir.

Q. And then in this period up to here, there [99] is far less water in the river than the amount of evaporation and transpiration?

A. Yes, according to this chart, we have in June, 1953, in the river 196 acre feet, and when we add to this figure the discharge and the subsurface flow —the discharge was 69 acre feet, and the subsurface flow was 30 acre feet, we have a total of 295 acre feet.

When we look at this chart, we see that we have an evaporation of 691 acre feet. That gives 396 acre feet that are not available. It means when you would have 396 acre feet more water flowing in the creek, it would be evaporated.

Q. May I express it this way correctly, Doctor, that after this point (indicating on chart), or, rather, after this point, if Bagdad quit pumping entirely, there would be a short period, depending on how many days that takes that curve to get up there when there would be still a discharge from the river down below? A. That is true.

(Testimony of Heinrich J. Thiele.)

Q. When you pass this point here, if you add what Bagdad has taken as 69 feet, it simply goes off in the air? A. That is true.

Q. And that would continue until the point [100] where those curves drop down?

A. To where your evaporation curve drops down here.

Q. Is that an unusual condition in these wasting streams of the west, Doctor?

A. No, this is usual. This is usual procedure. And the peaks sticking out are caused by the summer floods, but usually we have this drop of the surface flow and the rise of the evaporation.

Mr. Fletcher will tell you more about this.

Q. The peak that is indicated there of the summer floods, the red line where it goes up, is that of a lasting consequence in the river, or is it transitory? A. That is transitory.

Q. Why?

A. Because it is just caused by a short period of rainfall where the evaporation takes care of it nearly completely.

Q. If you look at the rainfall charts that have been introduced, Doctor, referring to the one which shows the daily chart readings.

A. We see here, on Evidence V, that in June—starting with May of the years from 1935, we have a shortage in rainfall in May and June, that is [101] pointed out by this deep surface water flow, and again a second shortage in the months of Oc-

(Testimony of Heinrich J. Thiele.)
tober and November, as we see very easily on this chart again.

This is the usual way with the stream flow curves in the southwest part. And this evidence shows this line with blue, the month where we are short in rainfall, with none, or only a trace of rainfall.

Q. Doctor, the effect of these summer rains, from the standpoint of recharging the basin, and building up a sustained flow, unless they are of a considerable duration, they have little effect upon your sustained stream flow, is that correct?

A. That is correct, because the permeability of the ground allows only a certain amount of water to enter the ground.

Q. I believe you have stated, Doctor, you have been studying this thing since February 18, approximately? A. Yes, sir.

Q. In the course of which time you have studied many records with respect to the condition of Burro Creek? A. Yes, sir.

Q. Will you tell us what is your considered [102] judgment as to whether or not, in the normal summer periods of normal summer rainfall, Burro Creek would, if Bagdad pumped no water at all, have a flowing stream at Mr. Zannaras' point of diversion?

A. No. It would be without any effect, because we see that the evaporation, the excess of evapotranspiration of 300 and 400 acre feet would take care completely of the amount of water pumped by Bagdad Corporation.

(Testimony of Heinrich J. Thiele.)

Q. In your judgment, Doctor, from your study of the basin there, the type of materials that are indicated as in that basin, in your opinion, is there any loss of water into that basin, in the sense of seepage into it, and following the old channel?

A. Yes, there is a certain loss, because of the observation made in the same strata in Big Sandy Valley.

Q. Generally, would you say it would be your opinion that the old valley through which, over which, rather, Burro Creek flows, would operate as an underground stream carrying off some of that water also?

A. It is a natural occurrence that the underground water flow follows the old stream channels. And we have found definite evidence in the Phoenix [103] area where the subsurface flow of the Salt River is not going over Phoenix, but is going over Mesa in a southern direction. And the same thing probably occurs here, where the underground water flow is following the old channel in the southwestern direction.

Q. Well, now, Doctor, I believe you have testified that in your opinion, based on your studies and those of Mr. Fletcher, there is a monthly water loss from the Bagdad sump to the Zannaras point of diversion of approximately a thousand acre feet?

A. In June?

Q. Yes, in June.

A. In June, when we assume a yearly evaporation of 60 inches, this figure given here is more

(Testimony of Heinrich J. Thiele.)

conservative. It is only 37 inches. We know that it is conservative. It is based on data from Bagdad, from the weather station at Bagdad, at an elevation that is more than 15 hundred feet higher than the Burro Creek basin.

Q. Let me see if I understood you.

This blue line on the chart which represents the evapotranspiration curve is based on a 37-inch——

A. A 37-inch basis, because we have actual data only on the station in Bagdad available. [104]

Q. So that that curve is based not on 60 inches, but 37 inches annually?

A. This is based on 37 inches. (Indicating) This is based on 75. (Indicating on chart.)

Q. 75?

A. 75 inches. And in between these two curves we have the real evapotranspiration. It is in between these two curves.

Q. Then it would be your opinion, Doctor, that the evapotranspiration potential as shown by that curve is actually underneath what it actually is?

A. Yes, it is underneath. We know that.

Q. Then, Doctor, starting, or assuming that basis, you would have to have a pretty substantial amount of river water put into the river at the top of that basin to have any come out the bottom in substantial quantities? A. Yes, you have to.

Q. One further thing I would like to ask you with respect to, Doctor.

You computed, I believe, the general dimensions of the river channel at the Zannaras mill?

(Testimony of Heinrich J. Thiele.)

A. Yes.

Q. You gave us the approximate width and the approximate depth of the gravels as you ascertained [105] them? A. Yes.

Q. In your opinion, Doctor, is there any substantial amount of waters in the underground gravels at Mr. Zannaras point of diversion?

A. Yes, there is a certain storage of ground water at the diversion point of Mr. Zannaras.

Q. Is there any way of computing the amount of underground movement of water at Mr. Zannaras' place, within any reason?

A. Yes, we can calculate this figure very easily the same way as we would calculate the other figure here. We know the slope of the water table, and we can assume a certain permeability of the material the same way as it is here.

Q. Did you examine the installation there at Mr. Zannaras' mill? A. I did.

Q. In your opinion, would it be entirely feasible to construct an underground perforated pipe installation there at bedrock which would catch all of the underground movement? A. It would.

Q. Which would be safe from floods and everything else? A. Yes, sir, it would. [106]

Mr. Wilmer: Cross-examine.

The Court: We will have our afternoon recess.

(Recess.)

The Court: Proceed.

(Testimony of Heinrich J. Thiele.)

Cross-Examination

By Mr. Morgan:

Q. Dr. Thiele, when you first took the stand, because the acoustics are bad here, I couldn't understand everything you said, so I would like to come back very briefly and ask you a few questions.

I thought you stated you first came to the United States in 1937, is that correct?

A. 1936, the first time.

Q. In 1936. And you did some work in the United States. Was that scholastic work?

A. I was a student at that time.

Q. Then I believe you stated you returned to Germany? A. Yes, sir.

Q. When did you return to Germany?

A. In 1938.

Q. In 1938? A. Yes.

Q. And you remained in Germany, I take it, until after the war? A. Yes, sir. [107]

Q. And while you were in Germany, you were engaged on water problems, as I understood it, largely?

A. Yes, sir, largely water problems, yes, sir.

Q. Then later on, after the war was over, you came to the United States?

A. I returned to the United States in December, 1952.

Q. 1952? A. Yes, sir.

Q. I take it, then, you are not a citizen of the United States?

(Testimony of Heinrich J. Thiele.)

A. No, I took out my first papers.

Q. I think you stated you were a mining engineer, had a degree in mining engineering?

A. I got my degrees in mining engineering.

Q. And also a geologist? A. Yes.

Q. Do you reside now in Arizona?

A. Yes, sir.

Q. Do you have a permanent residence in Arizona? A. Yes, sir.

Q. I presume you are registered, then, as a mining engineer, are you?

A. I am registered as a civil engineer. [108]

Q. You are registered as a civil engineer?

A. Yes, because this type of ground water work doesn't go in mining engineering.

Q. Sir?

A. I am registered as a civil engineer.

Q. In Arizona? A. In Arizona.

Q. By the way, were you employed, or are you employed by the Bagdad Copper Corporation in connection with its dam proposition, and the building and construction of a large dam?

A. I am employed by the Bagdad Copper Corporation in checking the ground water conditions of that area.

Q. All through that area?

A. All through that area.

Q. In other words, you have done work for the Bagdad before you undertook this particular job, is that correct?

(Testimony of Heinrich J. Thiele.)

A. No. I was consulted by the Bagdad Copper Corporation in this special case, but in a general way, that I may give evidence for other things.

Q. All right. Now, you mentioned, I think, in your testimony, this mountain that lies to the east of the river, of the Burro Creek, rather, and which the Burro Creek crosses not far from the [109] Zannaras point of diversion, was rising?

A. Yes, we have a rising area there.

Q. Could you give us any idea how much it is rising, the rate of rising?

A. I don't believe that any geologist in the state could give you an idea on that.

Q. Then I take it you don't know whether it is rising at the rate of, we will say, one inch in a year, two inches? A. This is insubstantial.

Q. Anyhow, if it is rising, it is imperceptible, is that correct?

A. We see only the rising condition by the outcropping bedrock and the shallow layer of gravels. When we would have stable conditions, we would have a much thicker gravel sheet. We wouldn't observe every year again outcropping bedrock.

Q. As far as you know, I take it it might be a hundred years before this rising would in any way affect the water running down Burro Creek?

A. That is true.

Q. Sir?

A. We don't know anything about the amount of rising.

(Testimony of Heinrich J. Thiele.)

Q. You mentioned in your opening testimony that you had examined some drill cores? [110]

A. Yes, sir.

Q. From what point on the river or the creek did those drill cores come?

A. These drill cores came out of the region northeast of Goble's farm.

Q. Could you point out on the map? I didn't understand your answer.

A. Northeast of Goble's farm. (Indicating on chart.)

Q. Would that be above or below the Bagdad point of diversion?

A. This is below the Bagdad point of diversion.

Q. And was it in the creek bed?

A. It was in the creek bed, and on the sides of the creek bed, on the mountain sides crossing the whole valley.

Q. Do you know how many holes were drilled, and what depth they were drilled?

A. These holes were drilled up to bedrock.

Q. Do you know how many feet they went down to reach bedrock?

A. Yes, I have a picture on that, but——

Q. Well, do you know?

A. Is this necessary for the court case?

Q. You can remember, can't you?

A. Yes, I can remember. [111]

Q. All right, how many feet did these drill holes go down?

(Testimony of Heinrich J. Thiele.)

A. These drill holes went down from a hundred to nearly 400 feet.

Q. From east to west across the bed of the creek?

A. Yes, sir.

Q. How far apart?

A. Some were only 20, 30 feet apart. Others were up to 300 feet.

Q. After you got through the top portion of the territory there, by that I mean the sand and gravel deposit that covers the stream bed, are you able to tell the Court what character of rock was encountered? A. Yes, sir.

Q. In those cores?

A. Yes, sir. We had a cover of gravels and clay gravels up to a thickness of 90 feet, and below that we had cemented material, this, what is called here in a cross-section, the fanglomerate-breccia. And on the bottom we came on to diorite.

Q. In other words, then, the sand and gravel is this 40 foot section that appears on the map or plat that I am pointing to now.

I don't know what the exhibit is. Could [112] you tell me?

The Clerk: Exhibit R.

Q. (By Mr. Morgan): On Exhibit R, is that correct?

A. That is correct.

Q. And the matter below that consists of clay, you say?

A. No, of gravels and clayey gravels.

(Testimony of Heinrich J. Thiele.)

Q. Was it a uniform depth across there, or was it deeper in one place than the other?

A. It was deeper in one place than the other.

Q. That is, when you got in the center of the channel it would be deeper, I presume?

A. If you come to the center of the channel, of an older channel, it is deeper.

Q. Did I understand you to say that the average width of this stream bed—when I say the stream bed I mean the part in which water, if there were water coming down, would cover it?

A. Yes, sir.

Q. Was about 200 feet wide?

A. 200 feet at this channel wide between here and here. 30 stations—215 feet exactly is the average width between the one station and the point where the creek is entering bedrock.

Mr. Wilmer: May the record, to clarify [113] that, show that the witness pointed——

Mr. Morgan: Below the Kingman Crossing.

Mr. Wilmer: And down to Mr. Zannaras' mill.

Mr. Morgan: Yes.

Q. (By Mr. Morgan): That would be 215 feet wide?

A. 215 feet exactly is the average width.

Q. And above the average width, which I presume would be covered with sands and gravels——

A. Yes, sir.

Q. Would average about how many feet in width? A. I have to measure it.

Q. Well, just approximately?

(Testimony of Heinrich J. Thiele.)

A. 2,000 feet.

Q. Now, would this whole 2,000 feet, in season when water came down, would that be covered with water, or would it carry water, or would only a small portion of it carry water?

A. We brought into evidence several cross-sections through this valley where you see exactly which part of the valley would be covered by water. (Indicating on chart.) You see the different elevation here.

Q. I don't want to be technical, Doctor, but I would like to have it in the record. Could you [114] tell us approximately how much, what part in width, average width would carry water on the surface. That depends on the time of the year and the size of the flow, doesn't it?

A. It depends on the strength of the flow.

Q. The average flow that would go down?

A. Average surface water flow is taking—it is hard to answer this question, because the southern part of the valley here is flooded far over at this time, so I cannot give you an answer on this question for the average conditions of the average year.

Q. Well, let me ask you this question, then. How much a part of this yellow zone that you say is 2,000 feet wide would be saturated with water, or carry any underflow?

A. The whole zone is fairly saturated with water when you are on a bank. That is 8 feet above the river level, that is, Station No. 17. And a little lower down, this station is situated, oh, about 150 feet

(Testimony of Heinrich J. Thiele.)
away from the river, and 8 feet above the river level. (Indicating on chart.) And you have boulders. And the next is sand. Then you just take your foot and scrape away a little bit of soil, moist soil. You see the degree of evaporation when you take a look into the soil. [115]

Q. All right, and would this flow be 200 feet across, 500 feet across? I mean, saturated, or would it be saturated for less distance?

A. The water table is near the surface in this area here, at least 500 feet.

Q. About 500 feet?

A. At least. I don't know it exactly. We have the cross-section for these different points, and if it is necessary, I am willing to study these points more clearly if you have a special point.

Q. What I am trying to get at is this. I understood from your computation that you took into consideration the width of this water-carrying body above the Kingman Crossing? A. Yes, sir.

Q. I thought you said you figured it 200 feet in width and 15 feet in depth?

A. Below the Kingman Crossing I figured 215 feet in width.

Q. What did you figure it above there?

A. Above there the area was calculated with the planimeter. Mr. Colville and I independently calculated the area with the planimeter.

Q. Can you give us some idea, then, about what the particular acreage of ground would be actually saturated with water, or would carry water? [116]

(Testimony of Heinrich J. Thiele.)

A. The whole width of water, of the valley.

Q. As shown on that chart?

A. As shown in this picture, because this picture is carrying water at a certain depth.

Q. Now, I presume that out towards the edges of this deposit that the depth wouldn't exceed a few inches, and then get deeper as it goes in, is that right?

A. That is right. Therefore, we have in another part of the valley the depth, or the thickness of 40 feet, while they are moving out to the edges of the valley to zero.

Q. You average the actual depth, then, as what? 40 feet?

A. No, we were very conservative. We averaged the thickness of the water carrying material only as ten feet.

Q. Ten feet?

A. Ten feet. We were very conservative.

Q. Now, then, you didn't take into consideration anything below this surface, this water-carrying surface as carrying water, did you?

A. No, we didn't take anything into consideration related to this picture. That is Evidence Y.

Q. The reason for that, I presume, is you [117] don't know—— A. We don't know.

Q. Whether that is——

A. We see only directly.

Q. Whether that is a water-carrying earth or not?

A. We know it had a certain permeability, but

(Testimony of Heinrich J. Thiele.)

we don't know the amount. We know we have the loss here. We see the water disappearing directly into the gravels, but we can't give any details.

Q. I presume your testimony would be the same with respect to this old channel that once cut across the mountains to the southwest?

A. That is the old channel I am talking about.

Q. This one is the old channel, is it?

A. This is the old channel, yes.

Q. On R?

A. This is the old channel on R that has been undercrossing today's valley.

Q. That is shown in R?

A. That is shown in R as the old channel, a cross-section through the old channel.

Q. The new channel doesn't have that depth, is that correct?

A. The new channel is only that part, the new channel is cut into this material that is rising [118] on the sides. (Indicating.)

Q. I see.

A. Up to a thousand—well, about. The mesas are a thousand feet higher than the river. Three or four thousand feet, yes.

Q. Do you have any idea what the original width of this old channel was at the surface?

A. Oh, yes. We have here the mountain range coming up, and on the other side we see them crossing out here. We have this width at the surface that was filled up higher than this. (Indicating on chart).

(Testimony of Heinrich J. Thiele.)

Q. Do you have any idea what the width would be at 1,200 feet, we will say?

A. You can calculate it out of this cross-section. One square is 2,500 feet wide. Two squares 5,000 feet. This whole channel is at the bottom here about 5,000 feet wide.

Q. You mean this is not a picture, not an illustration of the channel on its course, but a cross-section?

A. Yes, sir. It was going this way. (Indicating.)

Q. I see. Now, let us for a minute discuss this matter of evaporation. Of course, you have to have water before you can have evaporation, is that [119] correct? A. Yes, sir.

Q. Now, if no water passes the Bagdad point of diversion—— A. Yes, sir.

Q. We will say beginning about the first of May, or the first of April, assume that no water passes, then the only water that could be evaporated would be the water that was stored in this lower section, is that correct?

A. We can take that from Evidence X. We see here that in June, 1950—in June, 1951, no water was passing the Bagdad diversion point.

Q. Just sit down. I believe you stated that you have heard that there was a great deal of underground water passing that diversion point?

A. 30 acre feet a month.

Q. How did you come to that conclusion?

A. I gave the calculation of this table.

Q. Did you see a large excavation in the creek bed there that was made by the Bagdad people some

(Testimony of Heinrich J. Thiele.)

time ago in an endeavor to back up that underground flow of water below their point of diversion?

A. No, but we made a test hole there to find out about the gravel condition.

Q. Where was the, or what was the nature [120] of that test hole? A. I was told about this.

Q. I see. You made no test, then, to determine?

A. I didn't make any tests at the point myself.

Q. Then you don't know, I presume, from your own knowledge, whether or not any water passes down the creek beyond the point of diversion of the Bagdad underground or surface?

A. Underground or surface, we have a certain flow, because I made 65 resistivity test stations, and the thickness of the gravel sheet, even, related to sea level, and with that I have a certain picture of the flow conditions along the Burro Creek.

Q. At this particular point where Bagdad is taking out its water at its diversion point?

A. Yes.

Q. It is right on bedrock, isn't it?

A. Only on one side. I have been flying over this area very carefully again yesterday to take a better view above the diversion point of Bagdad Corporation, and I have seen very carefully, I have looked into this very carefully, and I have seen that we have a certain gravel sheet.

Q. At this point of diversion, did you make [121] any determinations in order to find out whether or not water was actually flowing underground alongside the, we will say alongside the Bagdad point of diversion?

(Testimony of Heinrich J. Thiele.)

A. I didn't make any geophysical study of it, but I made a study in looking at the area.

Q. But below the point of diversion you made a geophysical study?

A. Below the point of diversion I made a geophysical study.

Q. And while you were making that study during February, from February 18th to the present time, there is a very large amount of water running out of this sump?

A. It is a considerable amount of water that is running out of the sump.

Q. Could you tell us from the records you have before you the amount of water that is running out there, or do you have the records for that time?

A. Excuse me, please. I am looking for this yellow sheet. I am giving you comparable values for February, 1950, 1951.

Q. No, I am interested in 1954, if you have them?

A. I don't have the figures calculated for 1954. [122]

Q. Well, to the best of your judgment, how much water was passing the Bagdad sump at the time you made all these experiments and calculations?

A. I didn't get your question.

Q. How much water—I am not trying to trick you at all—how much water was flowing out of the Bagdad sump?

A. I didn't calculate it, because it isn't essential right now.

(Testimony of Heinrich J. Thiele.)

Q. Could you give us some idea whether it was a large flow or a small flow?

A. It was a comparatively large flow.

Q. Yes. And it ran down to this territory which is shown on the plat in yellow, is that correct?

A. Yes, sir.

Q. And it continued to run right down on past the Zannaras point of diversion?

A. That is true.

Q. All of this country, of course, was then saturated, that is, the surface, at least, down to a certain depth, was saturated with water?

A. That is true, to a certain depth it was saturated with water.

Q. All right. Now, to get back to this question of evaporation. Is there any difference in [123] evaporation of surface water and ground water?

A. Yes, sir, there is a difference, and you see the difference in these two curves I plotted on this chart. This is an evaporation of surface water, and this is the evaporation from a ground surface of the ground water.

Q. I am sorry. I can't see the plats. My eyes are very bad. If you will tell us about that. As I understand it, surface water, where the sun can get to it, it will evaporate very rapidly, will it not?

A. Relatively, yes.

Q. Isn't that correct? A. Yes.

Q. Underground water is not so susceptible to evaporation for what reason?

A. Underground water is susceptible to evapo-

(Testimony of Heinrich J. Thiele.)

ration, when you have a large surface, a large evaporation surface. When you have trees which have leaves, the water comes to the surface and it increases the evaporation, or the transpiration.

Q. I believe that is called aspiration, isn't it?

A. Transpiration.

Q. Transpiration, thank you. But those trees, of course, afford shade in summer? [124]

A. Nevertheless, they are using a tremendous amount of water, and we have evidence on the amount of water one cottonwood is using.

Q. But they do have shade there that tended to cut down the actual evaporation, isn't that right?

A. No. They didn't increase the—they decrease the evaporation, yes, but they increase the transpiration.

Q. That may be true.

Now, then, if the stream bed itself becomes denuded of water, and there is no water on the surface, and the surface becomes covered with dust and loose dirt, would that make any difference in the evaporation of the waters that were flowing beneath the surface?

A. When this sheet of clay, as you call it, as you may call it, is getting thicker than two or three feet, it naturally makes a difference, especially when it is drying out. But we don't have these conditions here. We don't have a clay cover. We have at least a sandy silt at certain places, and I had my trouble with this sandy silt. I hoped it was thicker. When I tried to sink my stakes in it, at a depth of three or four

(Testimony of Heinrich J. Thiele.)

inches I couldn't get hold any more, because there were big cobbles and stones. [125]

Q. You have heard of dry farming, haven't you? Dry farming?

A. I don't know this expression.

Q. That is where a man goes out and irrigates a field, then immediately, as soon as he can do so, he cultivates and mulches up the soil on top, and as long as that soil is loose, it will prevent the water from evaporating, and for a long time it cuts the evaporation, in other words. You know that, don't you, because it breaks up the capillary action of the surface?

A. The electric capillary action of the soil is given by the chemistry of the ground water, and especially by the chemistry of the interstitial water. I studied electrochemistry in college, and got my Master's thesis on the electrochemical question.

Q. Assume, in answer to this question, that in the summertime, in the dry seasons when there is no rainfall up in that section, the surface of the Burro Creek, and that part of the surface which is designated here particularly as in yellow, becomes dry? A. Yes, sir.

Q. The silt is dry and covers the surface maybe to a depth of two or three, or several inches, [126] wouldn't that tend to prevent evaporation, cut down evaporation?

A. Scarcely, because I observed not only in this area that we have a high conductivity in this surface layer. It would cut it down only to a very,

(Testimony of Heinrich J. Thiele.)
very small amount, but we still have a high evaporation because of the difference in electrical potential of the air and the soil.

Q. Would it be your idea, then, that even if Bagdad was not pumping, and the usual amount of water came in here in the dry season, according to the charts, that all this water would be used up, or practically all, before it got down to the Kingman Crossing?

A. Yes, it would be used up in the dry summer.

Q. It would be used up before it got to Kingman Crossing? A. Yes, sir.

Q. That is your opinion, then?

A. But we have a certain flow, when you put water into the ground, where it takes a long time, maybe several years to reach Kingman Crossing point. It means when you have a dry summertime, you have still rising ground water here, because that water that is starting to move here starts to flow very slow, very slowly. [127]

Q. Let me ask you this question. See if we can change your opinion.

If the evidence showed, or you knew from competent evidence that in all the years that this Kingman Crossing has existed, that in all the years, both before pumping operations by the Bagdad, and up to its present point of diversion, and at the present time, there has always been water, even in the driest seasons running down at the Kingman Crossing?

A. Yes. We don't have a surface flow any more,

(Testimony of Heinrich J. Thiele.)

but we have returning ground water there. You have to think that our water table is in Bogle's Farm 150 inches higher than at Kingman Crossing. This causes, naturally, a pressure and outgoing ground water at that point.

Q. Do you know from what source Burro Creek gets its main supply of water?

A. It has an intake area extending in a northeastern, northern direction.

Q. Do you know to what mountains?

A. I don't know the names of the mountains of the area, but I have a map with me where we can see the surrounding area, if you want to have a certain picture.

Q. I presume you know it doesn't get [128] much flow from Boulder Creek, that is the creek that runs by the Bagdad?

A. The Boulder Creek is giving only a certain amount.

Q. Its main supply is far up the mountains?

A. Yes, sir.

Q. I don't suppose you ever studied the rainfall records at the source, showing the rainfall at the source of Bagdad, at the creek?

A. I have only the rainfall records of Bagdad itself. There were not many records in this part of the country, as you know.

Q. I am not sure that I understood you. Did I understand you to say that it would pass through a cubic foot—is it a cubic foot—of this sand and gravel, a certain amount of water per day?

A. Yes, sir.

(Testimony of Heinrich J. Thiele.)

Q. Could you give me that figure again? I don't think I understood it.

A. One coefficient is defined by Meinzer as the rate of flow of water in gallons per day through a cross section of area of one square foot.

Q. Square foot, yes. I didn't get that clear. Let me see if I can understand it.

Say you take a square foot. Assume, now, that there is a square foot of earth? [129] A. Yes.

Q. Now, in one day—and it was existing up there on this Burro Creek near the surface, I presume? A. Yes, sir.

Q. In one day, how many gallons of water would flow through that square foot, in one day?

A. That is another one. This is another question, that is, the seepage loss out of the Burro Creek?

Q. No, no.

A. Do you think of a vertical or horizontal movement?

Q. Horizontal movement.

A. Horizontal movement.

Q. And the permeability of it.

A. (The witness handed a document to counsel.)

Q. I can't read it. Tell me.

A. I wanted to show you a picture that explains these things in this chart here, showing the movement of the water through one square foot, one foot in length, one foot high, when the drop of the water table is one foot in one mile, one mile difference.

Q. Now, Doctor, how many gallons, how many

(Testimony of Heinrich J. Thiele.)
gallons would flow through a square foot of [130] this soil, taking into consideration the fall of the ground, and all of that? A. Yes.

Q. How many gallons percolate through underground flow?

A. It depends on the slope of the water table.

Q. You have already testified to it, but I didn't get it clear.

A. I testified that the slope of the water table is 185 feet in three miles, and we brought this down to the figure of one hundredth, or one per cent slope of the water table.

Q. Then from that you calculated that water coming in here, we will say, at the upper end of the valley, or the deposit coming down, would percolate or pass through a square foot of soil?

A. The amount of water passing through a square foot of soil, according to the figure——

Q. That is what I am trying to get here.

A. ——at the table here would be 10,000 divided by a hundred, would be 100 gallons a day. (Indicating on chart.)

Q. 100 gallons per day?

A. Yes. We have here an area of 200 feet wide and 15 feet high, and you are asking for one square foot? [131]

Q. Yes.

A. You have to cut this out and take this as one here. Then we have only 10,000 divided by a hundred leaves only a hundred.

Q. 100 gallons a day?

(Testimony of Heinrich J. Thiele.)

A. Through one square foot.

Q. Then if it was 100,000 square feet?

A. You have to multiply by 100,000.

Q. That would be how many gallons a day?

A. A hundred thousand times 100 is ten million.

Q. Ten million gallons a day? A. Yes.

Q. And you don't mean by that that that is—well, I think that is understandable now.

On that soil, how much, assuming that we had a square foot of that soil, how much water would be contained in a square foot of that soil at any one time?

A. In these gravels will be contained, oh, about 23, 22, 23 per cent of water, and it will give free about 20 per cent. 20 per cent, it means the effective porosity is 20 per cent, while the total porosity is 33 per cent.

Q. In other words, if this entire deposit was all saturated with water at one time, the water [132] would be 20 per cent of the total——

A. The free moving ground water you can assume is 20 per cent of the total amount of the soil.

Q. Yes. And how much would that be in acre feet at one time?

A. It depends on the cross section. I can make a calculation on that.

Q. All right. Have you calculated it?

A. When you have that slope of the water table as we have above, it would be 2,000,000 gallons a day, but don't forget that this ground water is

(Testimony of Heinrich J. Thiele.)

dammed up in the southern end, and by the damming up we don't have the slope of the water table any more. We don't calculate with such a high slope.

Q. What I am trying to find out, really, is this. Assume for this question that all water is stopped from flowing down the creek at the narrowest point of diversion. By that I mean not only surface water, but underground water.

How long, or how many gallons would it take to fill this up again, or how many feet would be required to fill this deposit of water-carrying soil?

Mr. Wilmer: Are you assuming that it is completely denuded of water? [133]

Mr. Morgan: Yes.

Mr. Wilmer: Or just dry to bedrock.

The Witness: We can calculate the amount of water that is stored in this basin in the gravel sheet.

Q. (By Mr. Morgan): Just approximately?

A. Let us assume that you have—maybe you have ten feet. Then when we assume only a ten-foot layer——

Q. Yes?

A. Then we have approximately 4,000 acre feet.

Q. Yes. To refill it?

A. But these actions, as I pointed out, these actions are cutting one another. You have evaporation occurring in one area when you have refilling. You have the effect of evaporation in one area, when already the effect of refilling starts in the

(Testimony of Heinrich J. Thiele.)

other one, caused by the slow movement of ground water.

Q. Are you familiar with the lake Bagdad keeps up near its mill?

A. I am not familiar with it.

Q. You have seen it, haven't you?

A. I have seen it. I enjoyed its beauty. [134]

Q. Do you know how many gallons of water, the minimum gallonage, that is pumped by the Bagdad up to their mill?

A. Yes, the minimum amount of gallons pumped up to the mill is 520 gallons per minute, in June of 1953.

Q. Do you know what that increases to in the wintertime when there is plenty of water?

A. Yes, we have an average figure going from June last year to February of this year, giving a mean average of 707 gallons per minute.

Q. Some of that water is pumped directly into the mill, and some is pumped directly into the lake, I take it?

A. That is not my business. I don't know.

Q. Would you be able to tell us what the evaporation would be on that lake?

A. I didn't calculate the area. I didn't make any calculation.

Q. You said something about the evaporation being——

A. In a pan. That was pan evaporation observation of the Weather Bureau.

Q. That would be 75 inches a year, is that correct? A. Yes, that is correct. [135]

(Testimony of Heinrich J. Thiele.)

Q. Assume that Bagdad has 100 acres of lake, and that there would be pumped into it each year 600 million gallons of water. I take it that 75 per cent of that would be evaporated into the air?

A. Well, I don't know. We are not so sure about the total amount of evaporation on Lake Mead. We have just in the last years, we have several studies on the action of evaporation, and it figures 20, 25 per cent difference. And never forget that we have not the constant evaporation all year long. We have, as we see, that peak there at one time of the year, and in another time of the year we have a very low evaporation.

Q. Your figures from Roosevelt—I assume that was from the dam, wasn't it—show evaporation?

A. No. It was also pan evaporation.

Q. Is there any difference between pan evaporation and——

A. Between pan and lake evaporation there is a small difference only. I guess it is given in this book here. I have seen it, at least.

> "The evaporation data listed in Tables 4 and 5 of Appendix A, and in accompanying Table 1 are recorded and estimated pan evaporation rates." [136]

This is page 26 of the Lower Colorado River Basin report.

> "A conversion factor of 0.70 was applied to these land pan rates to reduce them to free water surface evaporation rates for estimating

(Testimony of Heinrich J. Thiele.)

> the evaporation from reservoirs, streams, canals, and all other water surfaces."

I am informed this figure of 0.70 is just an experience number, and is varying according to varying regions.

Q. Would you say that is a fair average, 75 inches for that country?

A. That would give, when you accept 75 inches, you would have to take 70 per cent of this for the lake.

Q. You are not a mining metallurgist, are you?

A. No, I am not.

Q. You wouldn't know how that water could be saved up there without loss?

A. I didn't try to go into this question.

Q. Well, assume that this lake up there maintained by the Bagdad, which is known as the tailings pond, has 100 acres of surface. Could you tell us just on that basis how much the evaporation would [137] be in a year?

A. I didn't study this question. I couldn't give you any answer.

Q. Can't you figure it out from your general knowledge?

A. No, I don't have any experience on lakes in this area.

Q. Don't you have it right in front of you there in that book that you are referring to?

A. I didn't understand.

Q. Doesn't that book show the evaporation from lakes and ponds?

(Testimony of Heinrich J. Thiele.)

A. As 70 per cent. But this pan is in another altitude. It is not at the lakeside there.

Q. Do you know what the altitude is at Bagdad? You know that, don't you?

A. The altitude at Bagdad is around 3,000, 3,500 feet.

Mr. Wilmer: If it makes any difference, we will agree that it be 70 inches. I don't know what difference it makes.

Mr. Morgan: Well, all right.

Mr. Wilmer: To shorten this up.

Q. (By Mr. Morgan): Now, your opinion to the effect that water, even when all the water was allowed to run [138] down this creek, wouldn't reach the Zannaras point of operation——

A. It could not reach the point——

Q. That is based simply upon your observation since you have been up there?

A. It is based on the figures of the Bagdad Weather Bureau station. It is based on rainfall, and the figures used by the Department of the Interior, the Forest Service, and other services for the calculation on the evaporation.

Q. Well, if the evidence introduced in this case heretofore disclosed without question that up to 1948, and before the Bagdad began its pumping operations from its present intake, that there was always a flow of water winter and summer down to the Zannaras point of diversion, would that change your opinion?

A. Before 1947 we had nearly twice as many in

(Testimony of Heinrich J. Thiele.)

rainfall as we had in the following years. And as I told you, the flow conditions of the ground water are very low, so that you feel the effect of a low rainfall only one year later on the outflow.

Q. Doesn't the plat you introduced in evidence show the two dry years were 1946 and 1947?

A. 1947 and 1948, so far as I can recall. We can look into this Evidence V. [139]

1947 and 1948, those years were abnormally low rainfall.

Q. 1946 was low, too, wasn't it?

A. 1946 had 15.92 inches.

Q. And what was it in 1947? A. 7.9.

Q. And in 1948? A. 9.2.

Q. Now, if the evidence that has heretofore been introduced in this case was before you, and from that evidence it was shown that apparently whenever the Bagdad was allowing 225 gallons of water to go down past its sump, that there was always water at the Zannaras point of diversion, would that make any difference in the opinion you gave here?

A. No, it wouldn't make any difference at all, because this amount of water would be only around 30 acre feet, and 30 acre feet, according to this evidence here, doesn't make any difference. And in the summertime when you have evaporation of 300 or 400 acre feet in addition to that amount you have in the river, it doesn't make any difference at all.

Q. In other words, regardles of what the facts

(Testimony of Heinrich J. Thiele.)

would be, that is, the actual facts as to the [140] history, you would still say, based on the rules and regulations that you are deciding this thing on, that it just couldn't happen?

Mr. Wilmer: If it please the court, we object to counsel assuming something which the record doesn't support. There is no such unity in the rule at all. I object to it on that ground.

The Court: You are arguing with the witness.

Mr. Morgan: I think that is all. Just one more question.

Q. (By Mr. Morgan): Going back to this evaporation at the tailings point. As I understand, that is a 100-acre pond, 100 acres of surface. Wouldn't you be able to figure, assuming that the evaporation was 70 per cent, and taking into consideration the acreage there on the surface, how many gallons would be evaporated off during the year?

A. 70 inches, I said, not 70 per cent.

Mr. Morgan: He said 70 per cent.

Mr. Wilmer: No, he didn't say 70 per cent.

Mr. Morgan: Oh, 70 inches.

The Witness: 75 inches, and 70 per cent of the 75 inches.

Mr. Morgan: Sir?

The Witness: 70 per cent of 75 inches when the [141] lake would be in the altitude of the pan.

Q. (By Mr. Morgan): How many gallons would that amount to in a year?

A. It would be about 450 acre feet total in the year.

(Testimony of Heinrich J. Thiele.)

Q. 250?

A. 450 acre feet as a total in the year.

Q. And I believe there is 325,851 gallons in an an acre foot? A. 325——

Q. 325,851 gallons in an acre foot?

A. That is correct. It is the correct figure.

Q. All right.

A. We are calculating here in acre feet?

Q. Yes.

A. And this whole figure, this whole evaporation would be 450 acre feet over the whole year.

Q. Then how many gallons would that be? If you multiply that by 326, we get the gallons, 326,000.

A. All right.

Q. I can't figure.

A. 352,000, I guess it was, or was it 326?

Q. 326, according to the formula.

A. 326. That would be 146,000,000 gallons in the year.

Mr. Morgan: All right, I think that is all. [142]

Redirect Examination

By Mr. Wilmer:

Q. I want to ask just a couple of questions, Doctor. From this point here, which is the Bagdad diversion point, approximately, to the Kingman Crossing is how far, do you recall?

A. About four miles.

Q. And from the Kingman Crossing to the Zannaras mill is approximately——

(Testimony of Heinrich J. Thiele.)

A. Three miles.

Q. So altogether, approximately 7 miles?

A. Approximately.

Q. Can you tell me how much higher this point, that is, the surface at this point is than the surface —to get the record straight, how much higher is the surface at the Bagdad sump than it is at the Kingman Crossing? A. About 400 feet.

Q. How many? A. 400 feet.

Q. Would you have a fall of 400 feet from this point? A. Approximately.

Q. To the Kingman Crossing? A. Yes.

Q. Now, I believe you have a term you refer [143] to as hydraulic pressure? A. Yes.

Q. Now, Doctor, assuming for a moment that we shut off all water at the Bagdad sump?

A. Yes.

Q. What effect does the water have which is lying immediately below the Bagdad sump on the water which lies below it in the basin?

A. It is running further on, because you have the pressure on the upper part of the valley in the ground water, so you have an outflow of ground water up to this point, where you have this water table, and where this water table is practically level.

Q. Is there a place where the water table is practically level when the stream is running?

A. Only when this part is dried out here.

Q. In other words, the water level tends to level itself off with the lip of the basin at Kingman Crossing? A. Yes.

(Testimony of Heinrich J. Thiele.)

Q. And until it levels itself off——

A. It is running.

Q. The water at the upper end tends to push the water down by hydraulic pressure?

A. That is true. [144]

Q. You made some observation, Doctor, with respect to the rate that water moves through gravel such as that. In other words, if I could put a tag on a piece of water that was entering the upper end of the basin, to follow it through the gravels and sand until it leaves the basin, could you testify approximately the length of time involved for that water to move from the upper end to the bottom or the lower end of the basin?

A. We could do that, according to Darcy's law. Well, I can say so much, that the movement of ground water has been rated up to, even through sands, from 60 feet a year up to half a mile a year, depending on the different permeability.

Q. Up to a mile. In other words, from 60 feet a year to a mile a year, depending on the——

A. The permeability of conditions.

Q. Depending on whether the material it is moving through is tightly knit or porous?

A. Yes. There have been made investigations in coloring the water with transfluent media so that people were able to determine the movement exactly in the different pump sites and wells as the water was flowing by.

Q. That, Doctor, being true, then, that is known

(Testimony of Heinrich J. Thiele.)

as Darcy's law, is it, or is that based on [145] experiments?

A. This movement of the ground water is known as Darcy's law.

Q. Then with that being a four-mile area, the ground water, the water which comes into the basin at Point B would be at least two or three years in moving underground to the bottom end of the channel?

A. That is true. But the particle of water itself —you know, when you take a U-shaped valve pipe and put water into this side, it is pressing the water on the other side to the same level, without that particle itself coming up to the level.

Q. In other words, I think I understand what you mean now. When you put in "X" gallons at the upper end—— A. It is pressing——

Q. It is pressing out "X" gallons at the lower end? A. That is right.

Q. Except that if the "X" gallons you put in at Point B is less than the loss from the surface, then the loss from the surface neutralizes the amount you didn't put in at the other end?

A. Taking into account the friction in the soil as you have it in the pipe. [146]

Q. Yes. What I mean, is this true, Doctor? I may be off base here.

Let's say you put an acre foot of water at Point B in June. If we had no evaporation or no transpiration—— A. That is right.

(Testimony of Heinrich J. Thiele.)

Q. That would result in an acre foot coming out at the bottom of the basin, wouldn't it?

A. Less that amount that is taken care of by the friction.

Q. In other words, the hydraulic pressure which that acre foot exerted at Point B would have to overcome the friction of the sands and gravels to push out an acre foot at the Kingman Crossing?

A. That is correct.

Q. Now, if the acre foot you put in at Point B is less than the amount which the basin is losing through evaporation and traspiration, what effect will that acre foot have at Point B?

A. It presses up the water to a certain point, but it is losing its effect very fast.

Q. Well, then, I take it the explanation, Doctor, for the fact that at Kingman Crossing there is always a flow of water is that the hydraulic pressure, even when the water is shut off at the Point B, or there is very little flow, or an acre [147] foot, as you have said, that nonetheless that storage up there is feeding—— A. Feeding——

Q. Is feeding the water and pressing it out the charge, then, to where, before the effect of the hydraulic pressure is exhausted, there comes the rain, and the dry period ends, and you have a restoration of the channel? A. Yes.

Q. Or the charge of the basin there?

A. Yes.

Q. Did you compute, Doctor, the amount of storage, assuming there is no permeability in the blue

(Testimony of Heinrich J. Thiele.)

portion of that Exhibit R, the amount of storage in the gravels and sands in the Bagdad basin—I am going to call it the basin—above Burro Creek?

A. We gave the figures before.

Q. I don't know whether we put that in or not.

A. It was exactly about 4,000 acre feet.

Q. You are assuming that there is——

A. Assuming that we have 10 feet.

Q. Ten feet uniform of saturable material in the area from the Bagdad sump to the Kingman Crossing? A. Yes.

Q. Then did you compute the water storage in [148] the basin lying below the Kingman Crossing and to Mr. Zannaras' point of diversion, as to how much water charge that would hold?

I believe there is 82 point something. 82.4 or 5.

A. 150 million cubic feet.

Q. 150 million cubic feet?

A. 150 million cubic feet.

Q. Can you relate that, now, or translate that, now, to free water?

A. This is the amount of ground water stored between Kingman Crossing and Zannaras station.

We have 15,000 feet of length of the channel, 200 feet of width—exactly 215. And I am taking again 10 feet as the average thickness of the aquifer, and I am taking the same figure as before of 20 per cent of effective porosity.

Q. In other words, 20 per cent of free water?

A. Yes. And this comes to 150 million cubic feet.

Q. All right, now 150 million cubic feet is how

(Testimony of Heinrich J. Thiele.)

many gallons? What I am getting at is there is always water at the Kingman Crossing, I think everyone agrees, which means that this basin below the Kingman Crossing is being supplied with water. Now, how much underground water does that hold? [149]

A. One cubic foot is 7.48 gallons. That gives about 20 million gallons between Kingman Crossing and Zannaras mill.

Q. In the underground gravels and sand?

A. Yes.

Q. 20 million gallons? A. Yes.

Q. In other words at such time as the sands and gravels below the Kingman Crossing are fully charged to the extent they will hold water, and I guess that is a constant figure, isn't it?

A. Yes.

Q. At that time there is then in storage there——

A. It is in storage.

Q. The figure you gave me of——

A. 20 million gallons.

Q. Of 20 million gallons.

How high is the Kingman Crossing above the Zannaras mill? Does it show on this thing here?

A. Yes. We can take it off. About 140 feet.

Q. From the Kingman Crossing? A. Yes.

Q. Then to the Zannaras mill there is a drop of 140 feet? A. Yes. [150]

Q. Now, counsel asked you some time as to the saturation condition of the materials lying in the basin above the Kingman Crossing.

(Testimony of Heinrich J. Thiele.)

Were you able to make any observations, Doctor, in your geophysical work, which would indicate to you whether or not there was a constant moisture from the surface down as you made these various tests, with respect to the resistance of the ground, the conductivity of the ground?

A. I observed by the conductivity of the ground we have a certain percentage of moisture practically starting half a foot or a quarter of a foot below the surface, up to the ground water.

Q. Is it correct that the content, moisture content of the soil has some relationship to the conductivity of the soil through electricity?

A. That is correct. We have even certain compilation curves between moisture content and resistivity.

Q. You made the statement that at one point some 150 feet back from the channel you could by digging down observe a moist condition?

A. Yes, sir.

Q. Did the fact that that condition persisted to the bedrock, was that borne out by the studies, the experiments you made on the reaction of the instrument [151] to the electric charge—to the electricity used?

A. Yes. We could differentiate very good.

Q. Did the results of your studies geophysically substantiate your conclusions that the entire area, or substantially all of it was pretty well permeated with water on the surface?

A. Yes, that is true, even when we take the com-

(Testimony of Heinrich J. Thiele.)

pilation curves for the moisture, between moisture and resistivity, we see that the point has been reached where there is a certain saturation.

That means when you draw up such a curve, looking like this, that you come—when you have your 10 per cent moisture, 10, 20, and so forth, then your values come down maybe from 100,000 ohmmeters steeply down until you come to the wilting point at 6 per cent, and the curve is levelling off at 15 per cent, something like that, or 20 per cent moisture content of the soil.

Q. Which is a high content, is that right?

A. Which is a rather high content and shows we have evaporation there.

The Court: We will suspend at this point until ten o'clock in the morning.

(Thereupon at 4:30 o'clock p.m. an adjournment was taken until 10 a.m. the following morning, March 10, 1954.) [152]

The Court: You may proceed.

HEINRICH J. THIELE

resumed the stand and testified further as follows:

Redirect Examination
(Continued)

By Mr. Wilmer:

Q. Doctor, you made a calculation yesterday with respect to the amount of water storage in the basin above the Kingman Crossing, and also below the

(Testimony of Heinrich J. Thiele.)

Kingman Crossing? A. Yes, sir.

Q. Have you had, or have you checked those figures with respect to their accuracy, and made a calculation that you wish to put in the record in place of the one which you made, on the ground that [153] it was inaccurate? A. I did.

Q. Will you tell us, if you will, please, the calculation with respect to the acre feet of water, storage water, or water other than surplus water, in the basin above the Kingman Crossing?

A. The storage in the upper basin above the Kingman Crossing is 2,700 acre feet.

Q. And below the Kingman Crossing?

A. Below the Kingman Crossing, 150 acre feet. The evapotranspiration of the whole area is 4,600 acre feet. The reduced pan evaporation——

Q. Pardon me just a minute. This figure you gave as the evapotranspiration over the entire period, is over what period of time?

A. It is over one year.

Q. Over a one-year period?

A. Yes. The reduced pan evaporation, according to the Bagdad weather bureau station, would be 5,800 acre feet.

Q. Wait a minute, Doctor. I am not following you. The pan evaporation is higher than the——

A. Is calculated for open water surface.

Q. That is higher than the evapotranspiration, is it not?

A. Yes, it is higher than the evapotranspiration. [154] These figures that they are giving on this

(Testimony of Heinrich J. Thiele.)

chart are for Bagdad. They are smaller than they are, really, in the area under investigation. That means the true evaporation value is between the two lines, between the evapotranspiration line and the pan evaporation line. The pan evaporation times 0.70 gives the evaporation of the open water surface, as given in the publication mentioned yesterday.

Q. I think you must have your figures twisted, then, because you said that the evapotranspiration for the year would be 12 thousand some acre feet, and the open pan would be 5 thousand acre feet. Did you say that? A. No.

Q. Maybe I didn't hear you right.

A. I don't remember that.

Q. Let's start it over again.

A. The evapotranspiration for the whole year as given in these figures there is 4,600 acre feet in the year.

Q. 4,600 acre feet per year?

A. Yes. And the reduced pan evaporation would be 5,800 acre feet.

Q. Okay.

A. The stream flow of 1953 was 6,400 acre [155] feet.

Q. That 6 thousand——

A. It is the flow at the gauge station, at the diversion point, 6,400 acre feet.

Q. That is surface water?

A. Surface water, and the ground water flow is 360 acre feet. The discharge by Bagdad——

(Testimony of Heinrich J. Thiele.)

Q. By discharge you mean what they take out?

A. What they take out is 1,100 acre feet. And the discharge by Zannaras pump station is about ten acre feet.

Q. I will ask that again. By discharge you mean what is taken out——

A. Discharge is the amount of water that is discharged out of the river.

Q. Taken out of the river?

A. Taken out of the river.

Q. That is transposing the 3 million gallons per year into acre feet? A. Yes.

Q. Which is approximately ten acre feet?

A. Approximately. It is exactly 3 million divided by 326,000.

Q. And the Bagdad discharge or take-out from the river is computed on what basis?

A. On the measuring values, on the meter [156] reading values.

Q. In other words, the amount, the figures that you have on Bagdad are related to the actual water taken out? A. Yes.

Q. Or 1,100 acre feet in the year 1953?

A. That is correct.

Q. The Zannaras figures are based on what, under his certificate, he claims he has a right to take out, 3 million acre feet? A. 3 million gallons.

Q. Three million gallons?

A. That is correct.

Q. Now, one other point I would like to clear up, Doctor, and that is this. Where you have a period

(Testimony of Heinrich J. Thiele.)

of dry weather to where there is no surface flow in the creek at the Bagdad point of diversion, or where the basin begins, what effect will there be on the discharge of water from the basin and at the Kingman Crossing when you have a summer rain which for a time gives you a surface flow?

A. May I make a cross section on the blackboard, please?

Q. Yes.

A. When we assume that this part of the [157] valley between the two points where bedrock crops out up here, and near the Bagdad diversion point, and near the Kingman Crossing, we have the following picture: This is again on a larger scale. This is the surface, and this is bedrock cropping out here, underlaying. This is the gravel sheet, the cemented material, the fanglomerate breccia in here. This is bedrock. (Witness indicated on blackboard.)

Then our water table is in the winter months near the surface, slightly going down at the upper end.

This relationship is constant so long as we have a surface flow. At the moment when the surface flow stops, we have the following condition:

The water that is flowing out at the Kingman Crossing into the creek to the Zannaras pump station is overflowing on this point of the subsurface dam, because of the pressure of this ground water.

The ground water is diverted again into surface water.

Q. Now, Doctor, if I may interrupt you just a minute, because the record won't quite show what

(Testimony of Heinrich J. Thiele.)

you are saying. You are indicating that at the upper end, or at the Bagdad sump, the pressure of that stored water there is pressing downward [158] against the water which is at the lip of the basin at the Kingman Crossing, and forcing that water out there?

A. Yes, it is. Let us assume a certain point in this curve here. (Indicating)

In May we have a discharge here of 500 acre feet. 500 acre feet. Now, let us assume that the surface water flow stops at this point up here.

Q. That is at the Bagdad sump?

A. Near the Bagdad sump.

We have then only the ground water flowing into the creek below the Kingman Crossing. That means with the outflow of the ground water out of this basin, and with the pressure, the amount that can flow out is decreasing.

The water table, this line, that was dropping down slowly, now falls to this point, coming down further and further until it reaches a certain point where, taking the friction and everything into account, there is no longer any outflow out of the basin.

In the meantime, there may come a flood, one of the summer floods in August, and this flood is filling up the basin again to a certain point, but only to a certain point, because of the permeability of the ground. The permeability allows only a certain amount of the flood water to flow [159] into the ground again.

Q. Doctor, when you have a flood that lasts, say,

(Testimony of Heinrich J. Thiele.)

for six hours, or a day, or something like that, does that completely recharge that basin to the impermeable material?

A. No, sir. There is only a very small amount that is flowing into the basin again.

Q. In other words, with respect to recharging the basin, as such, the summer flood has very little effect on it, is that correct?

A. Very little effect.

Q. Why is that again?

A. Because of the permeability of the ground, the permeability of the gravels allows only a certain amount of water to enter in a certain time.

Q. So that actually the water runs over the top without getting back down to fill up the basin again, is that right?

A. It fills up only to a small amount. It doesn't fill up very high, so we have this sharp curve here showing we have a sudden increase of surface flow, and then it is going down right away.

Q. All right, now, go ahead, if you wish.

A. Here we are reaching a certain point of the year, not in every year, only in those years where we have little rainfall, little streamflow, [160] where this ground water is depleted so far it cannot pass any more this underground dam at the Kingman Crossing. In years when we have abundant rainfall we have all the year overwater flowing over this.

Q. When we add some water, assuming your water level in the basin has dropped, you add a certain amount of fresh water at the upper end, at

(Testimony of Heinrich J. Thiele.)

the Bagdad sump, does that have any immediate effect on the outflow of the river at the lower end, or at the Kingman Crossing?

A. No, sir, because it would have to supply that amount that is evaporating at the upper part of the valley. It depends on the amount. When you would have to put into the valley—let us take this point of the curve here—100, 200, 300, 400 additional acre feet of water in order that you have an outflow down here, this amount of water is evaporated in the whole area, and it would have to be more than 400 acre feet in order that it could flow.

Mr. Wilmer: I think that is all.

Recross-Examination

By Mr. Morgan:

Q. Doctor, you were interrupted so much by counsel that I got all confused on the figures, but [161] am I right that your testimony is that the acre feet of storage water above the underground storage water is 2,700 acre feet?

A. 2,700 acre feet in the upper basin.

Q. 2,700 acre feet that is underground?

A. That is calculated on the area of 1,300, 1,374 acres.

Q. Yes, sir.

A. And with a ten-foot sheet of gravel saturated with water, and an effective porosity of 20 per cent.

Q. Below Kingman Crossing, is it your testimony that there is 150 feet——

(Testimony of Heinrich J. Thiele.)

A. 150 acre feet calculated for a length of the valley of 15,000 feet between Kingman Crossing and Zannaras pump station, the width of the valley of 200 feet, the thickness of the aquifer of 10 feet, and 20 per cent porosity.

Q. Those are scientific calculations?

A. Yes, sir.

Q. Now, Doctor——

A. Based on the actual observations made by geophysical tests and actual borings.

Q. Now, Doctor, you say that during a year this 2,700 acre feet of water will evaporate how many acre feet? [162]

A. Evapotranspiration?

Q. Yes. A. Is about 4,600 acre feet.

Q. 4,600 acre feet?

A. When the water is available.

Q. When the water is what?

A. When the water is available in the whole area.

Q. That is on the assumption with water running down?

A. Not the river water, the ground water is available in the upper part of the basin. When no ground water is available any more, it cannot evaporate so much.

Q. Below the Kingman Crossing, what did you figure the area of evaporation?

A. This takes into account the area below the Kingman Crossing, but we can divide it up.

(Testimony of Heinrich J. Thiele.)

Q. All right. Now, the evaporation is——

A. It is 1,374 acre feet above the Kingman Crossing, and 82.5 acre feet below the Kingman Crossing, and we calculate it with three feet. That gives above the Kingman Crossing, roughly calculated, 4,000 acre feet, the actual figures from 4,600 is calculated out of the evaporation curve, and out of the actual values, but, roughly, it would give [163] 4,000 acre feet above and 250 acre feet below the Kingman Crossing.

Q. 250 acre feet? A. Yes, sir.

Q. Now, then, you figured separately the surface water? A. Yes, sir.

Q. The evaporation of the surface water?

A. Yes, sir.

Q. Above the Kingman Crossing. What was your figure?

A. This is the other curve plotted up here. (Indicating on chart.) 0.70 per cent of the pan evaporation, which is 75 inches in Bagdad, 70 per cent of 75 inches is about 4.5 feet. 4.5 times 1,374 acre feet gives about—these are only roughly calculated, now—6,000 acre feet of pan evaporation in the upper basin.

Q. Six thousand?

A. Yes. The exact value for the whole thing was 5,850. And below, 4.5 times 82 acres, that gives about 370 acre feet below the Kingman Crossing.

Q. Well, now, excuse me, Doctor. Have you finished your calculation? A. Yes.

Q. Are we right that your calculation is

(Testimony of Heinrich J. Thiele.)

for [164] underground water above the Kingman Crossing, 4,600 acre feet? A. Yes.

Q. Now, let us get it straight. What would be the total evaporation for a year on the surface water, that is, the stream water, above the Kingman Crossing?

Mr. Wilmer: Pardon me. Is counsel assuming that the entire basin is covered with water, or is he asking the witness to calculate from what knowledge he has the amount of evaporation from the actual stream itself?

Mr. Morgan: I am talking about the actual stream.

The Witness: The actual stream evaporation is taking into account only the width of the stream itself, but evaporation is of the whole surface of the valley.

Q. (By Mr. Morgan): That would include underground water?

A. We have the evaporation of the whole—let us put it this way. We have, when the water table is at the surface in the lower part of the basin, we have the pan evaporation figures. When the water surface is below—the ground water table [165] is below the surface, we are coming to the evapotranspiration figures.

Q. How much below the surface?

A. According to the calculations, two feet.

Q. Then it is your testimony, is it, that in this portion of the basin above the Kingman Crossing, from underground sources, any water two feet

(Testimony of Heinrich J. Thiele.)

below the surface, that there would be a loss of 4,600 feet by evaporation.

A. 4,600 evapotranspiration.

Q. Well, now, then, how about the surface water? As I understand it, in surface water you include—do you include everything above down to two feet, any water that is in this territory down to two feet? A. Yes.

Q. As well as the actual running stream, itself?

A. Yes.

Mr. Wilmer: Pardon me. I can't understand the question or the answer, either.

The Witness: The pan evaporation values are from open water surface, and open water surface is only existing when the water table is practically at or near the surface, within two feet of the surface. [166]

Q. (By Mr. Morgan): All right, I understood that. When making your calculation, now, or can you give us a calculation of what the loss would be for that surface water?

Mr. Wilmer: Are you referring now to the actual water, or to what the situation would be if it were covered with water? I don't understand your question.

Mr. Morgan: You don't understand your witness.

Mr. Wilmer: I am sorry. I don't understand your question. I ask that counsel frame the question so we understand whether he is talking about

(Testimony of Heinrich J. Thiele.)
the actual condition existing, or a theoretical condition, if the area was covered with water.

Mr. Morgan: Let us forget that.

Q. (By Mr. Morgan): What did you call the pan evaporation——

A. Let us talk about the evapotranspiration, because this is the figure, that is the lowest figure.

Q. What I want to know, then, is what would be the figure for the running water, the actual running water that is on the surface?

A. I cannot give you the figure.

Q. You cannot give me that?

A. No. [167]

Q. You said something about 6,000 acre feet. What did that comprise?

A. This figure is only for the whole basin, when the water table is at the surface of the whole basin.

Q. That would only be changed if there was no water at the surface?

A. Yes. We have it in the later part of the year in the upper part of the valley, of the basin.

Q. Let us go down below the crossing, then. Do you figure any surface flow loss down there?

A. Of course, the water table is all year over near the surface.

Q. Near the surface? A. Yes.

Q. And you don't really actually figure any other loss from the 250 acre feet below the Kingman Crossing, is that right?

A. That is correct. 250 acre feet of the evapotranspiration.

(Testimony of Heinrich J. Thiele.)

Q. All right. Now, then, you don't mean to say, do you, that all this territory which is shown on this exhibit—the mark is covered up, I have forgotten what number it is—well, the exhibit which I am pointing at, that which is marked in [168] yellow is actually a running water carrier? By that I mean the whole stream doesn't flood that surface?

Mr. Wilmer: At what time?

Mr. Morgan: Ordinarily, I am talking about.

The Witness: This basin is supplied by the river with water. The river is supplied with ground water for this basin, bringing it up to a certain point.

Q. (By Mr. Morgan): Yes, sir. Now we are getting somewhere. Now the actual river channel or stream channel above the Kingman Crossing averages what width? I am talking now about the running water channel.

A. It is changing between 100 and 500 feet.

Q. We are not talking about when there are floods.

A. No. Also in this part of the year it is changing. There are areas where it is very narrow and other parts where it is very wide.

Q. How do you account for that?

A. Because of ground water that is coming out of the soil. It is dammed up. We have a damming up.

Q. I understand that at the Kingman Crossing there is a barrier? A. Yes. [169]

Q. And when that surface water gets down there it tends to pile up and spread out. What I am try-

(Testimony of Heinrich J. Thiele.)

ing to find out is what is the width of the actual channel that carries this water?

Mr. Wilmer: Surface or underground?

Mr. Morgan: Surface water.

Mr. Wilmer: The witness is plainly confused. Do you mean surface water or underground water?

The Witness: There is no actual channel here of surface water, because the valley is rather even, as we have shown in one of the pictures here, and the water is spread over this area.

(Indicating on chart.) When you see the surface elevation of this cross-section here, you see that you cannot talk about a channel, a dug-in channel into the ground.

Q. (By Mr. Morgan): Take your seat. Maybe we can get to it a little better than that. Isn't it a fact, from your observation made when you were doing this work, that you went up and down this river channel, and particularly the part of the river channel that carried running water, isn't that right?

A. Surely. I made several observations, but I did not go there with especial attention to see the river channel. [170]

Q. Isn't it a fact that the river channel, or the carrying channel is, generally speaking, in the center of the territory, this territory that is marked in yellow?

A. You see that on the chart there, that it is not always in the center, that it is at either one side or the other.

Q. That is right, it may go to either side, but,

(Testimony of Heinrich J. Thiele.)

generally speaking, it is in the lowest part of this whole basin? Isn't it set right there? That is the channel?

A. I don't understand your question, the lowest part of the basin?

Q. Yes. Water naturally would run to where the——

A. You mean at the deepest point in the basin?

Q. All right, call it the deepest.

A. Not necessarily, because it may cut in after the next flood another storage, another area where it is cutting in.

Q. This basin, from the river—let us get this straight. This basin from the water-carrying portion of the stream itself rises on either side, doesn't it?

A. No, it doesn't rise necessarily. You may have just a little bend filled up by the last flood [171] that the year before the actual course of the water was a hundred, 200, 300 feet, 500 feet away.

Q. You don't mean to say that this whole territory marked in yellow is absolutely flat, is it?

A. No. As you see, on this plain here we have several areas where we have lower points.

Q. That is right. The stream, the water itself would tend to follow the lower points, isn't that right? A. Yes, it does.

Q. And then from those lower points, the valley slopes up on each side to some extent?

A. To some extent. And it comes down again, it slopes down because it is filled up with gravels,

(Testimony of Heinrich J. Thiele.)

and it cuts down again underneath that deepest point.

Q. Isn't it a fact that this actual river channel that carries the water ordinarily is at least eight feet on an average above the territory that goes through, below the territory that goes through?

A. No, that is not true. We don't have a channel here. We have a flood plain, to a certain extent.

Q. We are not talking about a flood. I am talking about the ordinary flow of water.

A. You cannot talk about a channel that is [172] dug in eight feet deep, that is impossible.

Q. How many feet deep would you say it was?

A. As you see on this chart again, you cannot talk about a dug-in channel at all. It is sloping slightly up, and you see that this is within a few feet covering a wide plain. Therefore, we made this investigation to show this to the court, that we don't have a channel here, but we have a plain which is sloping up and down, but dug by the river, by the creek.

Q. Sloping up on either side?

A. Not sloping up even, sloping down at certain points.

Q. All right. Now, then, we will assume that water runs continuously down this plain here, that it is not a vast amount of water, but the ordinary run of water. We will assume it runs continuously. It would follow a course, wouldn't it?

A. It would follow a course. Each water particle follows a course.

(Testimony of Heinrich J. Thiele.)

Q. And how wide would that course be?

A. This course is changing, as I mentioned already, between 100 feet, less than 100 feet, even, up to 500 feet width.

Q. The 500 feet width would be down at the Crossing? [173]

A. Not only down there. It is up to point 16, in all this area here (indicating), it is widening out, coming together again.

Q. Let us get this, then, Doctor. Your observations made beginning February 18th, did you actually see a running stream of water any place in this territory that was 500 feet wide, that is running?

A. Not running.

Q. Sir?

A. It is not running. It is moving to a certain degree, because always water is obeying the law that it is falling to a certain direction.

Q. You did find places where it had a definite width, say, of 20 feet, maybe 30 feet?

A. Well, no, not 30 feet. A little bit wider. You can say 50 to 100 feet is the least of the width.

Q. That was actually covered with water?

A. Covered with water, and single boulders were sticking out.

Q. All right. Now, then, if that water ran continuously 30 feet or 50 feet wide down this territory, how far on either side would that water percolate?

A. The percolation of that water is taking [174] the following course. Here is the river, the actual width of the water, and it will be feeding into the

(Testimony of Heinrich J. Thiele.)

ground water this way. (Indicating.) It is coming here through the ground water surfaces. It is feeding in this area, and the calculation is made how much water is going into the soil here, depending on the permeability of this.

Q. Yes, sir. It wouldn't feed upwards to the surface on either side?

A. It is pressing up. Yes, it is pressing, because this point is higher than the point—higher than the other areas, so it is feeding into both directions, into both sides of the valley.

Q. How long would it take to extend out 600 feet on each side?

A. For the single water particle it takes quite a bit of time.

Q. I believe you said 60 feet a year it was going down?

A. For a single water particle, yes. We were talking about that figure yesterday, but the pressure, the higher pressure of this water is pushing up the other particles here. There isn't only the movement, but the pressure. It is not static, it is dynamic, the movement of water.

Q. Was I right in saying that you testified [175] that on its course downstream that the movement would be at the rate of about 60 feet a year?

A. I was testifying that this is the movement—that the movement of ground water in one year can be between 60 feet and half a mile. I think I gave that figure yesterday.

(Testimony of Heinrich J. Thiele.)

Q. And of course going down it would travel faster than it would to either side?

A. It can only go according to the slope. The slope is making a difference.

Q. Now, there is some controversy among us, and I don't understand this. I think this plat, which is in blue, I think you said, at least that was my understanding, that that blue simply represents a cross-section of the old river channel?

A. Yes, sir.

Q. Is that right? A. That is correct.

Q. In other words, this old river channel ran across this way? (Indicating.)

A. That is correct.

Q. And the upper portion represents the present channel that runs across it?

A. That is correct.

Q. Now, in making your experiments, did you follow the river down to the Zannaras point of diversion [176] below the Kingman Crossing? That is, personally?

A. Yes, I did. I didn't follow it this way, as you pointed out. I went from Zannaras pump station to Kingman Crossing.

Q. I see. You didn't examine the terrain in between, then? A. Yes, I did.

Q. You did?

A. Yes. But I started with my investigation at Zannaras' pumping station and went to Kingman Crossing.

Q. Well, you made some experiments here with

(Testimony of Heinrich J. Thiele.)

your machine at what points below the Kingman Crossing?

A. The points I mentioned on this chart here, these points I made observations, and these points. (Indicating.)

Q. I see. Those on the chart.

Mr. Wilmer: To get the record straight, you are referring to Defendant's Exhibit R?

The Witness: Yes, R. Survey stations 7 to 33.

Mr. Wilmer: That is the stations shown above the yellow line on top of the bedrock? Those are where you made your observations? [177]

The Witness: Yes, sir.

Q. (By Mr. Morgan): This creek channel after it passes the Kingman Crossing flows into what is practically a canyon, doesn't it? A. Yes, sir.

Q. Did you go through that canyon?

A. I did.

Q. Did you see the falls there?

A. I did.

Q. Could you estimate how much water in February was going over that falls?

A. I did not estimate it.

Q. Could you tell us about it, how much water in width and depth?

A. I cannot tell you. I didn't estimate it at all.

Q. You couldn't even make a guess?

A. No, sir.

Q. I asked you yesterday about borings that were made, and you told us that you—at least, I

(Testimony of Heinrich J. Thiele.)
understood you to say you had some borings made across this territory below the dam?

A. Below the diversion point there were a number of borings made.

Q. Did you have that done? [178] A. No.

Q. I mean, was it done while you were there?

A. Yes, some of them were driven while I was there.

Q. Some of them? A. Yes.

Q. Which ones were done while you were there?

A. I don't know the numbers.

Q. Well, was it the ones in the river channel?

A. It was— (Indicating.) All these borings were made inside the yellow area.

Q. But you don't know which ones were made when you were there?

A. I remember one boring, but I don't remember the number.

Q. Where? Could you point out where that was made on the plat?

A. This region here, near point 5. (Indicating on chart.)

Q. That is the only one you know about?

A. Yes.

Q. How deep did that one go?

A. I don't remember.

Q. Did it go 10 feet, 50 feet, maybe?

A. No, about a hundred feet.

Q. You have no idea, I take it, as far as [179] you are concerned, you don't know whether the other borings were made that you looked at?

(Testimony of Heinrich J. Thiele.)

A. I have seen the bore samples, but I don't know the place.

Q. When they were made you don't know?

A. No, sir.

Q. Are any of these borings, to your knowledge, within the bed of the creek proper?

A. Yes, sir.

Q. Yesterday you testified that water couldn't possibly run down the surface of this river from the Bagdad point of intake to the Zannaras point of diversion in the dry seasons?

Mr. Wilmer: No, he didn't testify to any such thing at all, your Honor.

Mr. Morgan: I understood he did.

Mr. Wilmer: If counsel will impeach him in the proper fashion, fine, but I recall no such testimony.

Mr. Morgan: Well, except in times of flood.

Mr. Wilmer: I recall no such testimony at all.

The Witness: I didn't testify that. I was pointing out the actual figures of 1953, where we have a certain amount of water flowing at the station, at the diversion point of the Bagdad Copper Corporation, and only pointing out that according [180] to the evapotranspiration, the flow inside of this area is taken care of in this year 1953. In other years these conditions are different. These are flow conditions only for the year 1953.

Q. (By Mr. Morgan): Sit down, Doctor. Didn't you testify that it was your conclusion that in the ordinary year, and with the ordinary water that is available in that creek, that because of the high

(Testimony of Heinrich J. Thiele.)

evaporation that the water couldn't possibly run on the surface——

A. No, I testified——

Q. Down to the Zannaras point of diversion?

A. I testified yesterday that in June, 1951, and June, 1952, there was no water passing the diversion point of the Bagdad Copper Corporation, according to the gauge station measurements, but that at that time water could pass the Kingman Crossing, so far as the groundwater was passing out here, which amount can be calculated.

Q. All right; what is your opinion today? Assume that the Bagdad people were not pumping any water from the sump during the dry seasons. Could you give an opinion as to whether or not that water, if allowed to go down, would reach the Zannaras point of diversion?

A. This water could not possibly reach the [181] point of diversion of the Zannaras.

Q. Your testimony, then, is the same as it was yesterday?

A. It is the same as it was yesterday.

Q. Would that water reach the Kingman Crossing?

A. It possibly could not reach the Kingman Crossing.

Q. Sir?

A. It could not reach the Kingman Crossing.

Q. It could not reach the Kingman Crossing, either? A. No.

Q. That is your definite opinion?

(Testimony of Heinrich J. Thiele.)

A. That is my definite opinion.

Q. Based upon your calculations as to evaporation, and your knowledge of what the ordinary flow of water would be coming down that creek?

A. Yes, sir.

Q. Therefore, it was your opinion that even though the Bagdad people take all the water at their point of diversion, it makes no difference, because it would never reach Zannaras?

A. In June of the years 1950—1951, 1952, and 1953.

Q. That is your opinion?

A. That is my opinion, as you can plainly [182] see on this chart. We get here only a flow of 200 acre feet, and when you look up the list of the gauge readings of 1951 and 1952, you see that this flow is zero. It means it is still lower than 1953, while the evapotranspiration is taking out 400 acre feet when the water is available.

Q. And you say that under such conditions the water wouldn't even reach the Kingman Crossing?

A. No, sir.

Q. Now, Doctor, you weren't acquainted with the situation up there? That is, you don't know the history of this stream, do you?

A. I don't understand——

Q. I will ask you this question: If you had before you definite evidence on the part of the plaintiff whom we are representing, or one of its witnesses, that from April through the fall of 1950 he always saw water, running water at the Kingman

(Testimony of Heinrich J. Thiele.)

Crossing, and that the flow of water there varied from a thousand gallons a minute to no lower than 200 gallons a minute, would that change your view that this water couldn't run down?

A. No; it wouldn't change my view, because it is in part ground water that is coming out at the Kingman Crossing.

But may I criticize your question? Are [183] these figures based on gauge readings, gauge station readings?

Q. Based on everything.

A. I am pointing out——

Q. If Mr. Schultz said——

Mr. Wilmer: If it please the Court, I object to counsel arguing with the witness.

Mr. Morgan: I was answering his question.

Mr. Wilmer: I object to counsel arguing.

The Court: Well, you have his testimony and this man's testimony. It is for the court to weigh it. You can't argue with this witness.

Q. (By Mr. Morgan): Now, Doctor, if you had before you the testimony of Ernest J. Green, a witness for the plaintiff in this action, given in this court, that on the 21st day of July, 1951, he made a measurement a little less than a quarter of a mile below the Kingman Crossing, and a cross section of the channel was a little over 24 inches wide and six inches deep, and that the rate of the flow was six feet in 15 seconds, or 24 cubic feet a minute, which would mean about 179 and a fraction gallons per minute, would that evidence tend to change your

(Testimony of Heinrich J. Thiele.)

opinion that this water—— A. No, sir. [184]

Mr. Morgan: Just a minute.

Mr. Wilmer: Just a minute. We make the same objections. He can't pass on that.

The Court: Sustained.

Q. (By Mr. Morgan): Then if you had the testimony given by Mr. Dickie, given in this cause, that in October, 1950, in the October, 1950, dry season, that at the Zannaras pump there was approximately 5,000 gallons a minute being delivered there, would that change your testimony?

Mr. Wilmer: Same objection.

The Court: Same ruling.

Q. (By Mr. Morgan): Or if you had before you the testimony of Mr. R. L. Daniel, testifying for the plaintiff in this action, that from August to December, 1950, he crossed the Kingman Crossing practically once a week, and that there was running water in that crossing, would that change your opinion? A. No sir.

Mr. Wilmer: Same objection.

The Court: Same ruling.

Mr. Morgan: That is all.

Mr. Wilmer: That is all.

(Witness excused.)

The Court: We will have our morning recess. [185]

(Recess.)

The Court: You may proceed.

Mr. Wilmer: I would like to recall George Colville for just one question.

GEORGE W. COLVILLE

recalled as a witness for the defendant, having been previously duly sworn, testified as follows:

Direct Examination

By Mr. Wilmer:

Q. Mr. Colville, you were sworn and testified previously? A. Yes, sir.

Q. In connection with the question asked you as to the length of time that your survey party was in the field, in connection with your survey, you answered it was two days.

What portion of the survey did those two days cover?

A. I was referring to the days that we made the survey between the Kingman Crossing and Mr. Zannaras' point of diversion.

Q. By his point of diversion, you mean the point of diversion set forth in his application?

A. Yes.

Q. That two days was consumed in determining where his true point of diversion was as reflected [186] in his application and certificate?

A. Yes, sir.

Q. Now, with respect to determining the width and area of the channel from the Bagdad sump to the Zannaras' mill, how much time was spent?

A. Altogether approximately a week, with two field parties.

(Testimony of George W. Colville.)

Q. In the field? A. In the field.

Q. So that the survey as shown by the yellow on the map there, which is the defendant's Exhibit M, I believe—no, N in evidence, there was approximately a week, with two field parties, making that survey? A. That is correct.

Mr. Wilmer: That is all.

Mr. Morgan: Could I ask a question?

Cross-Examination

By Mr. Morgan:

Q. George—I can't remember your last name?

A. Colville.

Q. In making that survey, did you make any survey of the channel itself? When I say the channel, I mean that the channel that the surface water runs down? [187]

A. You mean did we measure it?

Q. Yes.

A. Oh, if you could call it a channel, the wide stretches where there was water present at the surface, we surveyed that all out as we went along.

Q. As I understand it, you would find wide stretches of the water? A. Yes.

Q. For instance, at the Kingman Crossing, it is pretty wide there? A. Yes.

Q. And I believe there is another place below the Bagdad point of diversion where it comes up against rocks, and spreads out?

A. Well, the entire creek plain spreads out and

(Testimony of George W. Colville.)
widens out, and narrows down. There is no uniformity to the width of it.

Q. I understand that in some places it is wider than others, but on the whole it would average about how much?

Mr. Wilmer: Is counsel referring to the flowing stream, or the——

Mr. Morgan: Flowing stream. He knows what I am referring to.

Mr. Wilmer: I don't.

The Witness: You mean the water? [188]

Mr. Morgan: Yes, just the water.

The Witness: Well, we didn't take that at each point. Those were scattered sections across there, so I couldn't say about the average width of it.

I know it was pretty wide at the Kingman Crossing. It was approximately 100 feet wide, with saturated ground on both sides of the open water.

Q. (By Mr. Morgan): But farther up there were places where it was not nearly that wide, was it? A. Occasionally there were narrow places.

Q. Generally speaking does this channel have banks on either side? A. No.

Q. Was the territory on either side higher than where the water runs, the ground, I mean?

A. Well, in some places it is, although in some places the ground appears to be lower than where the water is actually running.

Q. Of course, the water would have to follow the lowest point?

(Testimony of George W. Colville.)

A. That is the natural tendency, everything being equal.

Mr. Morgan: I think that is all. [189]

Mr. Wilmer: That is all.

(Witness excused.)

Mr. Wilmer: Mr. Fletcher.

HERBERT C. FLETCHER

called as a witness for the defendant, having been first duly sworn, testified as follows:

Direct Examination

By Mr. Wilmer:

Q. Will you state your name, please, for the record?

A. Herbert C. Fletcher, F-l-e-t-c-h-e-r.

Q. Where do you live?

A. I live in Phoenix.

Q. And what is your work?

A. I am in charge of the research, the water shed management research for the Forest Service at Tempe.

Q. For the Forest Service?

A. For the Forest Service at Tempe.

Q. Tell us first, please, something of your educational background.

A. Well, I am a graduate of Forestry and Geology from the Utah State Agricultural College.

I have a B.S. from there. [190]

(Testimony of Herbert C. Fletcher.)

I have a Master's Degree from the University of Missouri, in soils and sedimentation.

And I have Doctor's work at the University of Oklahoma, in soils and sedimentation.

Q. How long have you been connected with the research work you are doing at the present time?

A. Since 1948.

Q. When did you leave your educational pursuits and start in actual practice?

A. In 1935.

Q. And since that time have you been engaged in work related to water, soil management, and so forth?

A. I was employed by the Soil Conservation Service down in this country in 1935 until 1939.

I have been engaged in water conservation work.

During the period I was in Washington, D. C., I had charge of the Division of Water and Forest Information for the Forest Service.

Q. Have you had occasion in connection with your work over this period of time to conduct experiments, and make studies, write papers, with respect to water losses from soils, among other things?

A. Yes, I have been engaged here ever since I [191] returned to the southwest in 1948.

Q. Where have your experiments been conducted?

A. Most of our studies I have been connected with are at the Sierra Ancha Experimental Forest. That is about 40 miles north of Globe.

(Testimony of Herbert C. Fletcher.)

Q. And with respect to Roosevelt Lake, where is your station?

A. We have studied all around Roosevelt Lake, at various locations, at different elevations, ranging from the lake level up to the higher elevations, and the fine fir type, about 7,000 feet.

Q. Did you have occasion to make an examination of the Burro Creek area, from the Bagdad Sump down the creek, in the area that has been discussed here in the evidence?

A. Yes, I have flown over the area, and I have gone down the Creek and examined the Creek channel.

Q. When was that done?

A. That was, let's see, Monday. Monday.

Q. This past Monday?

A. This past Monday.

Q. Before going into some of the scientific work you have done, in your flight over the area, that was for the purpose of getting a general aerial view of the entire area, is that correct?

A. Yes. I wanted to get a general view of the [192] area, and the vegetation associated with the area, and the general geology, aerial geology of the area.

Q. In that connection, you heard Dr. Thiele testify with respect to the general topographical conditions, should I say, of the area with respect to the mountain range which he described, and the appearance of an old channel where the Burro Creek enters the mountain range? A. Yes.

(Testimony of Herbert C. Fletcher.)

Q. Generally speaking, Doctor, did your observation confirm those conclusions?

A. From the aerial observation, I would say, that I made, I think that there is definitely an older river stream, that is older than the present Burro Creek, that cuts across the general terrain.

Q. Referring to the exhibit which is in the upper right-hand corner of the board there, the brown markings on that, does that generally confirm, or generally indicate your impression of the general course of the old channel?

A. That looks approximately correct, as far as I could tell.

Q. Now, Doctor, have you made certain experiments and studies with respect to the losses of water from the soil due to transpiration, and, in connection with that, evaporation? [193]

A. Yes. I have conducted quite a number of studies on evaporation losses from—not only from bare soil, and from different types of vegetation, I have lysimeter—for the record, a lysimeter is a closed, you might say, pot. They are larger than actual pots, but they are a closed bottom container, in which blocks of soil are placed in them undisturbed, and then we sometimes take the plants as they exist right in these blocks of soil, and transfer them into these lysimeters, so that we can measure the evaporation and the transpiration losses under different types of water saturation.

Q. Do you have a publication of the, what is it, the Forestry Service, which illustrates the type of

(Testimony of Herbert C. Fletcher.)

experiments and examinations and studies that have been made in that connection?

A. Yes. (Handing document to counsel.)

Mr. Morgan: I think we will object to that. To save time, we don't contest this witness' qualifications.

Mr. Wilmer: The purpose of it, if it please the Court, is to, without going into a great deal of detail through testimony, to support the value of these studies by showing how they are made. If he wants me to take in detail the whole thing to support the value of the findings they have made, [194] I can do that.

Q. (By Mr. Wilmer): This was prepared by you, is that correct?

A. Yes, I prepared this.

Q. And this represents the studies that have been made, the various experiments that have been conducted, and the conclusions that have been drawn from those studies?

A. Well, it shows you the various types of instruments we use in determining evapotranspiration, and also the measurements we have made at various locations there under controlled conditions.

It would show also what a lysimeter is, and some of the relations between the use of different types of vegetation, their use of water in relation to stream flow.

Mr. Wilmer: It is not offered as evidence—it is offered, if it please the Court, as showing the studies that have been made by this witness, and

(Testimony of Herbert C. Fletcher.)
for the purpose of demonstrating the method used, and the probable validity of the reports achieved.

The Court: All right.

The Clerk: Defendant's Exhibit Z in evidence.

(Said document was received in [195] evidence and marked Defendant's Exhibit Z.)

Q. (By Mr. Wilmer): Now, Doctor, have you had occasion with respect to various elevations, and various types of temperature exposure, and so forth, to have made certain studies, and to have prepared certain graphs and charts to demonstrate the loss of water?

A. Yes, I have. I have from the data and information that we have collected, I developed several types of graphs, or several types of—examined several types of conditions, and portrayed them in graphs which show the relationships between precipitation, stream flow, and evapotranspiration.

Q. And with respect to what particular areas and points?

A. I have examined, I guess, every weather station in the southwest, that is, Arizona, New Mexico, and west Texas, in which I have precipitation and temperature records available.

Some of those that I have examined I can illustrate here for you, some of those that would correspond to the subject.

I have them at Flagstaff. I have them at Alpine, Childress, Texas, Kingman.

I don't have them graphed up for Jerome, Roose-

(Testimony of Herbert C. Fletcher.)

velt, Wickenburg, Ruby, Arizona, [196] Safford, Springerville, Phoenix, Flagstaff, McNary.

In fact, I have them for most weather stations throughout the southwest.

Q. Doctor, in other words, you have engaged exceedingly extensively in studies over the southwest, with relationship to water losses from soils under varying conditions? A. That is right.

Q. Did you have occasion in connection with the situation at Burro Creek to work with Doctor Thiele in the preparation of the graph, or whatever you want to term it, which has been put up here, and has been received in evidence as——

Mr. Wilmer: If it please the Court, this, I believe, I did not offer, which I should offer at this time, being Defendant's Exhibit Y for identification.

The Court: It may be received.

The Clerk: Defendant's Exhibit Y in evidence.

(Said document was received in evidence and marked as Defendant's Exhibit Y.)

The Witness: Did I prepare this?

Q. (By Mr. Wilmer): Did you work with Doctor Thiele in the [197] preparation of the information, and the portion of the chart?

A. Yes, I worked out the—I charted by the use of formula developed by Dr. Thornthwaite, in an approach to rationalization and classification of climate, in which a formula has been developed by

(Testimony of Herbert C. Fletcher.)

him, which I have used in all of these studies that I have.

Q. Who is this gentleman you referred to?

A. He is a member of the—let's see, he is the consulting climatologist for Johns Hopkins University.

This is more or less probably the accepted method of classification and rationalization of climate.

I have taken this formula and adapted it to the conditions here in Arizona, and adapted it to the development or the measurement of stream flow.

Q. You would say that in your opinion and judgment and adaption you have made results in an accurate and reliable formula to apply?

A. Yes, I would. I have a publication now, or in process of being published, in which I have taken all of these various precipitation stations and analyzed them, and developed a map of the southwest which shows the various water-using areas, [198] and their relationship to sediment, and that is now in the process of publication.

Q. That is one which you, yourself, have prepared?

A. That is right. And I have taken the same information, information of the same type, and plotted it for Bagdad, which doesn't have as long record as some of the other places that I have plotted, but it does give you the same general picture.

In other words, you don't have quite the length of record there that you have at Phoenix, for example, or Tucson, or Yuma, or a lot of these other

(Testimony of Herbert C. Fletcher.)

places, but you do have a fair record, and it indicates somewhat the same general conditions as I find in other places.

Q. All right, now, Doctor, you speak of an application of this formula. Would you tell us how that is applied, what factors you consider, and so forth?

A. Well, you take the temperatures, the evapotranspiration. The thing we are getting at is some way to figure the evapotranspiration.

Evapotranspiration is a very difficult thing to measure, because there are so many factors that come into it, and by taking the temperatures [199] and the precipitation, and applying it into this formula, we can make out a potential evapotranspiration curve.

And this curve is then a balance between the precipitation of the area, and the temperatures, and the humidity, and those climatic factors of that type.

Q. You say the potential evapotranspiration. Why do you say "potential"?

A. I say potential because it doesn't necessarily say that that is what occurs continually. It doesn't occur in areas that are not completely supplied with water, like you would have in this channel we have been talking about. The water table there is high.

Out on the slopes of this area you have an entirely different situation. There is water available at one period of the year. There isn't any available at the other period of the year. Consequently, the

(Testimony of Herbert C. Fletcher.)
evapotranspiration isn't as high there as it is down below, because there is not the water to be evaporated or transpired.

Q. Then in this Exhibit Y, whenever the language "evapotranspiration potential" is used, it refers to the amount of water which would be evaporated if at all times—— [200]

A. If there were available at all times water being supplied from underneath.

Q. So that if in a period of shortage the water isn't there, the potential is there, but the water doesn't escape because it is not there to escape, is that right?

A. That is correct. I have another chart here which you may want to look at a little closer, which shows what the evapotranspiration rate is over this area.

I used this as a basis for developing, when I was developing these curves in the original, of trying to get at what the evapotranspiration was. I took the precipitation and plotted it in inches per month against the months. In this direction (indicating). Then I took the water used by plants under normal conditions, and you find that it pretty generally follows the precipitation pattern, except when temperatures are lower, in the months of January, February and December or latter November and December, when you get colder temperatures.

Consequently, plants are more or less dormant during those periods, some types of plants. Consequently, precipitation will rise above the use in some

(Testimony of Herbert C. Fletcher.)
periods, and in both ends of the year, [201] when there is naturally a lag between the vegetation and the precipitation, because vegetation doesn't start to grow until along in April, to any great extent.

Then you have a decline in precipitation during March, and June, July; then in July you have the coming up again, and then in August and September you have the summer rains, which are characteristic of the eastern part of this, which would be characteristic here in the Bagdad area (indicating on chart).

It is not true over in the western part of the state, necessarily, because the influence of the summer rains is not as large over there as it is in the eastern section.

Then as you come down in the winter, the precipitation actually goes up in the winter, and your vegetation comes off again.

Then if you plot, using the formula as developed by Mr. Thornthwaite, you plot the evapotranspiration of that, you will see the potential there goes up as high as ten inches in the Roosevelt area, which is a little higher, I think, than we find in Bagdad. Although it corresponds quite generally.

Q. Now, referring to the fact that the use of [202] water by plants, generally, follows the precipitation line, lagging somewhat behind it, is that true that it relates to the ordinary normal soil conditions?

A. That is the general over-all picture of the southwest. I would say this relates pretty generally

(Testimony of Herbert C. Fletcher.)

to the general over-all picture, not taking into consideration plants that are at the Valley bottoms, where you have an excess, or you have an accumulation of water from the winter periods, on either side.

Q. Now, under the conditions that you have spoken of where the plants are in the water, I mean, where they are in the water-bearing area, that is, they are in a valley close to the river, or there is a saturated surface, how does the consumption of water by such plants compare with the consumption of water by a plant growing up on a bank, we will say?

A. Plants that have, as we say, their feet in the water continually, that is, their roots in more or less, where there is no stress on the plant as far as moisture is concerned, then they would pretty generally follow this evapotranspiration curve.

Mr. Wilmer: Will you mark this for [203] identification?

The Clerk: Defendant's Exhibit AA for identification.

(Said document was marked as Defendant's Exhibit AA for identification.)

Q. (By Mr. Wilmer): Now, the graph you have been referring to is Defendant's Exhibit AA for identification.

For the purpose of the record, would you state exactly what the various lines on that indicate?

A. Well, the dashed line indicates the precipita-

(Testimony of Herbert C. Fletcher.)

tion during the year, that is, the average for Arizona.

The solid line is the water used by plants with optimum water supply.

Of course, you have to realize that this is, for most of the vegetation in Arizona, this is an artificial condition, because most of the vegetation doesn't have it, but as we call them phreatophytes, or those plants that have their feet in the water, this would be about a normal condition.

Then the other line, the "X"-ed line shows the water used by plants under normal conditions, that is, under conditions where they don't have all of the water available that they need for [204] growth.

Q. I take it that the use of a plant under normal conditions, according to your study, Doctor, then would be around three inches, and the use under optimum conditions would be under ten inches?

A. That would be the maximum by months. During April the maximum use would be about three inches. During the summer months, about three inches.

Q. And correspondingly, in those same periods, the use——

A. The use under other times of the phreatophyte type of vegetation would be nine or ten inches.

Q. When you say phreatophyte, do you mean any particular type of vegetation?

A. No. That is one that has its feet in water. They are distinguished from the hydrophytes, the

(Testimony of Herbert C. Fletcher.)
ones that grow directly in the water, and the phreatophytes have their roots very close to the free water table all the time.

If there is any stress, any point in their growing season where they have to send down excess roots, they generally show that stress in wilting very rapidly.

Q. Have you made any measurements or experiments [205] to determine the amount of water which a given type of vegetation will transpire in a given period of time?

A. Yes, I have made quite a few measurements.

We have different types of grasses. I measured, I guess, thirty or forty different types of grasses that are shown in that bulletin there.

We have measured Manzaneta, Oak Brush, and the Zarophrytic type of plants.

We did take a plant like Manzaneta, and give it all the water it would use during the year and we found it uses water continually during the entire year, where grasses make no growth at all in the winter months and in the fall months, and do some little growth in the spring, but never put out seed stalks, and most of their growth is during the summer months when they make their growth on the summer moisture.

Q. Are you familiar with the literature with respect to examinations made of cottonwood and mesquite, and similar types of vegetation?

A. Yes, I am acquainted with that in a general way.

(Testimony of Herbert C. Fletcher.)

Q. Generally speaking a cottonwood of substantial size will use a lot or a little water? [206]

A. Oh, let's see. I think in Safford Valley, the U.S.G.S. have a report in which cottonwoods use as high as six acre feet of water.

Tamarisk is another one that uses between six and seven acre feet.

Baccharis, a type of willow, will use between six and seven acre feet of water.

Q. And what about mesquite?

A. Mesquite is a plant that is a little different from either one of them.

Mesquite will grow if it has a lot of water available, will use, I would say, oh, between three and four acre feet. It is not quite as high a user as some of the others, although it will grow much deeper than some of the other plants for water, if necessary. It is a type of plant that—well, it is in between. It is sort of a Zarophrytic type of plant, which is a drought-resisting plant.

Q. Now, in the course of your examination, I take it you did go down the creek, Doctor?

A. Yes, I went down the creek and examined the channel.

Q. Did you have occasion to examine the type of vegetation found in the channel?

A. Yes. I found that there is cottonwoods, [207] and black willow, along with quite a little mesquite, and along with catspaw.

Q. Would you please explain to me, Doctor, what

(Testimony of Herbert C. Fletcher.)

the evapotranspiration curve is, and how it is arrived at?

A. Well, evapotranspiration curve is the amount of water that will be evaporated or transpired by vegetation during the entire year.

Q. Is it or is it not a matter of considerable importance to you in determining the probable water loss of an area to ascertain whether or not it is covered or is not covered with vegetation, and the type of vegetation?

A. It is very important, yes. We rely on it almost entirely in determining types of areas, where we can expect water yields at all.

Q. And why is that?

A. Because it relates the precipitation and temperatures to the water yield.

Q. Will an area which is denuded of vegetation yield more water than one which is covered with vegetation, or is that a proper question?

A. That is an old question. From our studies that we have conducted at the experimental forest, we find that bare soil uses about as much water. There is about as much water evaporated from bare [208] soil as from areas covered with grass, or areas covered with shrubs.

Q. Why is it, then, the question of whether there is or is not vegetation important as to an evapotranspiration curve determination?

A. Because when you have vegetation on the area, it evaporates more water, there is more water lost.

(Testimony of Herbert C. Fletcher.)

Q. Now, going to this specific problem, Mr. Fletcher. From what source did you get the figures that you used in computing the curve which is shown there as the potential, evaporation potential?

A. First of all, I plotted, I made this chart here in which I took the long time records of precipitation and temperatures from the Bagdad Station, which is the official records of the Weather Bureau. You can get them out of the official Weather Bureau records.

Mr. Wilmer: May this be marked for identification?

The Clerk: Defendant's Exhibit AB for identification.

(Said document was marked as Exhibit AB for identification.)

The Witness (Continuing): They are published monthly and [209] yearly each year. I took those long time averages which I plotted using the formula of Mr. Thornthwaite, and plotted the evapotranspiration curve, which is this solid black line here (indicating).

Q. You are referring to Defendant's Exhibit AB for identification?

A. Yes.

Then I plotted the precipitation as recorded in the official Weather Bureau records, by the dashed line.

Then allowing for a certain amount of soil and moisture storage; in other words, when vegetation

(Testimony of Herbert C. Fletcher.)

starts to grow, there is a certain amount of precipitation that is stored in the soil, so that in order for any water to be available for stream flow, the soil has to be above what is termed field capacity.

In other words, there is still considerable moisture in the soil when it is below field capacity. Consequently, with so much moisture stored in the soil, as your evapotranspiration curve begins to rise, which the vegetation uses to grow on, you have a point that is below the amount of precipitation that is available as this vegetation grows it depletes the soil moisture down to what we [210] term the wilting point.

And below that point the vegetation begins to wilt, and a lot of these phreatophyte type of plants, they will die.

Our desert zarophrytic type of plants have a faculty of being able to go dormant during those dry periods. Consequently, they live from year to year.

After they have exhausted this moisture, there is no more moisture available in this period of red in the chart; and you will notice that the dashed line, even though the precipitation in the summer months comes up in July and August and September, it never supplies enough moisture to satisfy the evapotranspiration needs, or what would be evaporated and transpired if it were available.

Then as you come over to November, the evapotranspiration curve falls down, and the precipitation curve comes up.

(Testimony of Herbert C. Fletcher.)

It takes a certain amount of moisture. It takes so much precipitation to raise that soil moisture back up to field capacity, or the point where water will run through the soil and contribute to stream flow.

I am speaking of this in broad, general [211] terms over an area.

Then after the soil is at field capacity, you have, in the Bagdad area you have a very small part there where it is at field capacity, or above, in which water is contributed to stream flow.

If you were depending on the water that fell in the immediate Bagdad area for the mills, or whatever water rights you are contending for here, you would have but very, very little water in that stream, and most of it would be in the underground channel, because there isn't any water there. There isn't any water that actually is available. It is all used up by evaporation and transpiration, every bit that would be available.

Consequently, you are getting water that falls back in the higher reaches of the watershed, and is coming down through the sands and gravels, which is more or less protected in a general way from the evaporation when it gets down deep.

However, these plants that are along this channel are continually pumping out, they are just like you would have a pump in the valley bottom, and they are continually pumping out this water, and they will take it much deeper. [212]

Mesquite roots go down as far as forty, fifty feet.

Cottonwood roots will go down twenty, thirty

(Testimony of Herbert C. Fletcher.)

feet, and they are capable of pumping that out just the same as if you have a pump there, as far as lowering the ground water table.

Q. Now, in that connection, the potential, the evapotranspiration potential as shown at Bagdad there, insofar as the supply of water in the basin is concerned, the red would indicate the relationship between the actual precipitation there, and what would be lost through evapotranspiration if there was other water there?

A. That is right. I first had to plot this in inches, because that is what I have precipitation given in, is inches of precipitation per month.

Consequently, I have to plot the evapotranspiration curve in inches. And then we change that, we transposed that into acre feet, into this curve here.

Q. Now the curve that you just indicated in the Exhibit, which is "R," I believe—no, that is "Y."

A. Y.

Q. "Y" in evidence, represents the potential loss, potential loss of water through [213] evaporation and transpiration in the Bagdad basin below there, according to the calculation which you made?

A. Well, I would say, actually, I think, as Dr. Thiele brought out, the precipitation, the gauges are at a little higher elevation than actually in the bottom here. I think you would find, if you had it down in the bottom, they would be higher down in the bottom of the valley than they are up here.

Q. Is there a direct relationship between temperature and elevation, as to the loss of water?

(Testimony of Herbert C. Fletcher.)

A. Definitely, yes. It is not as great as you might think, however. Because, as I say, it depends on the time of the year that the precipitation occurred.

For example, now, at Flagstaff we have about twenty-three inches of precipitation.

Take over on the Gila, down on the Gila, at the head of the Salt River, and some of those areas down there where you have the same amount of precipitation, but it occurs principally in the summertime.

I can illustrate that here by a chart that I have, I think.

Well, here it is, too. This isn't the one I had reference to, but, take Flagstaff, for [214] example. Here is the chart of evapotranspiration and precipitation at Flagstaff, and it shows the area that we might expect water yield to occur.

Here is the evapotranspiration curve. Here is the precipitation curve in the dotted line.

You notice we have quite a high sum of precipitation, and in July it gets up as high as three inches. The total is about twenty-three inches for a year. But you also have a high winter precipitation, which is up to about two inches in January, and the same thing in February.

Consequently, you do have quite a lot of water left over for stream flow.

Here is Alpine, Arizona. Notice you have the high precipitation in the summertime, but it never quite reaches the evapotranspiration, the peaks of

(Testimony of Herbert C. Fletcher.)

what is actually evaporated and transpired, but you have some, you don't have as much available for stream flow over there as you do in Flagstaff, because it occurs primarily in the summertime, rather than in the wintertime, when evapotranspiration losses are lower.

Q. Now, the amount of surface evaporation from the basin, from the sump down to the Zannaras' mill, I believe has been determined as approximately, in July—— [215]

A. Well, the rainfall down here is indicated as about two inches during August. July is about an inch and a half.

Q. And the loss of water during that period of time in the basin is what?

A. Well, the losses during that time in inches is about, is a little over seven inches, so you have a difference there of, take in August, three against seven. You have got five or four inches difference.

Q. Your calculation, based upon your accepting the area as surveyed, in other words, accepting the fact that it has thirteen hundred and some acres in it, without having checked that yourself, it would be your conclusion that in that period of time out of that thirteen hundred acres exposure, there would be lost seven inches of water over the entire area?

A. Oh, yes, at least that. That is, if it were available.

Q. That is what I mean.

A. Now, as Dr. Thiele tried to point out this morning, you have that relation, that hydrostatic

(Testimony of Herbert C. Fletcher.)

head that has to be kept at a uniform rate over the entire basin.

Q. Assume that during the period of June [216] and July that surface were kept saturated, the stream bed were kept alive with flowing water, in your judgment there would be a loss of seven inches times 1,342 acres, or whatever it is?

A. That is right. That is the figure that we arrived at. It comes up to about approximately nine acre feet.

Q. About nine acre feet?

A. Nine acre feet of water for that area. It comes up to 886, actually.

Q. Eight hundred eighty-six?

A. Yes, 886 acre feet.

Q. During that one month alone?

A. That is right.

Q. Assuming that there is an acre foot per day underground flow, or under surface flow at that point, or thirty acre feet, per month for those two months, it would be necessary, then, to put into the stream at the Bagdad point of diversion approximately 820 or thirty acre feet to get any results at the bottom of the basin?

A. Yes, pretty generally, I would say, because as this chart shows, the flow, the stream flow is particularly low. That means that the upper part of the basin has been pretty well generally drained. It is draining down. Its hydrostatic head is not as [217] great. This chart that he drew here this morning illustrated in a general way that thing.

(Testimony of Herbert C. Fletcher.)

And, of course, you would have the vegetation that is puffing that out. It is humping it out, at more levels than actually the hydrostatic head is.

So you would have the vegetation escaping, taking it all out or down to the wilting point of the soil or gravel.

Q. That is taking out the whole deficit between the thirty acre feet underground, and the surface flow, if you put it in there?

A. That is right.

Q. Assuming if we have an underground flow of thirty acre feet passing that Bagdad sump, that would leave a net 853 feet of water which would be required to get any water to the end of the basin?

A. You would have to have, I would say, somewhere around 800 acre feet in order to get any flow that is there. There has to be that much water. I will say this, there would have to be that much water coming into the basin continually to keep the flow at a uniform point over this point (indicating).

Q. All right, now, what would be the effect if, instead of putting 853 acre feet in there to get some live water at the end of the basin, we [218] would put in 400 acre feet in that period? Would it have any effect on the resulting output of water at the bottom of the basin?

A. Well, it would have a little, because you would raise the hydrostatic head a little, and of course that is a—you also would begin to increase your vegetation, your phreatophytes, they would begin to creep

(Testimony of Herbert C. Fletcher.)

up the channel a little farther than they actually are, because they can grow a little better.

So the more water you put in along the channel, the upper part of the channel in here, you would just tend to bring your ground water table, keep it raised up in this area. Consequently, the vegetation will increase in this area.

Most of your vegetation now is concentrated in this general area (indicating).

Consequently, it will start creeping up here, and it will start pumping it out.

It can pump it out as good as any of the rest of us.

Q. Is this the case:

The water which goes into the stream at the Bagdad sump during this period of time when your evapotranspiration loss is high would simply go to supply the evaporation loss, and that way to [219] supply the results coming out of the bottom of the channel?

A. Yes. You have got to take in here any water that is put in this period in here, after it passes this point, or after it comes to this point, any water that is put in there could be used by evapotranspiration (indicating on Exhibit).

Q. When you say it could be, Mr. Fletcher, do I understand that you mean that it is possible it would be, or that if it was there it would be?

A. If it was there it would be. It is not always there. That is what I mean.

Q. What effect with respect to restoring and

(Testimony of Herbert C. Fletcher.)
recharging the basin do these flash summer floods of rain have, assuming that it has dropped down below the normal capacity?

A. Well, they tend to raise the bottom precipitation available, as you can see it.

And from my chart here, this is the one where the precipitation begins to increase, you have definitely more water available, but it is not sufficient to take care of this thing (indicating), the difference in there.

Consequently, this is the longtime average at Bagdad. Well, this is the longtime average. This is just the one year, so actually [220] I doubt if you plot the longtime average of the figures available, it wouldn't cross this area. It would stay down here, and look like this (indicating on Exhibit).

Q. Let me see if I understand that.

The evapotranspiration potential loss which you have charted is based on the longtime records of Bagdad, to the extent they are available?

A. That is right. I think they go back about ten or fifteen years. I am not sure of that.

Q. I believe Dr. Thiele said they are both on 1953. As a matter of fact, you prepared that portion of the figures, or the Exhibit?

A. I prepared this portion here.

Q. And contrary to what he thought, your portion of the Exhibit was taken from the longtime records of the area?

A. That is right. I can't rely on one year.

(Testimony of Herbert C. Fletcher.)

Q. The water flow, subsurface and surface, and Bagdad use, is based on actual 1953 records, you understand?

A. Yes, these figures here, the red and green figures are 1953 figures.

Q. And the rainfall charted below is 1953?

A. The rainfall is the longtime average. [221]

Q. So that in years when the water use would be above, I mean, when the waterfall, the precipitation would be above 1953, it would reflect the red line accordingly, wouldn't it?

A. That is right.

Q. Now, that was what I was getting to, Doctor. Assuming that we have a summer flood, several of them, as far as that goes; if the use of downstream water, or if the flow of downstream water in a period of shortage has dropped your water table at the upper end of the basin there right below the Bagdad sump, how much effect do those summer rains have on filling that back up to capacity again?

A. I don't think they have too much effect, as far as filling the ground water basin is concerned. Certainly, they do supply some water to the first two or three feet of soil, as that water runs over the top, because the longer you have the water there, the more you get into the soil.

But most of these summer storms, we figure, and our studies show that we get very, very little usable water from the summer storms, [222] other than the flash flood that comes down the arroyo.

Q. Let me put it this way. The red line which

(Testimony of Herbert C. Fletcher.)

is on that "Y" in evidence really has no relationship to the average water availability in the stream during that period? Would that be a fair statement?

A. Well, it does for this particular year.

For the longtime average, I think you would find it would be more like this (indicating).

Actually if you plotted stream flow into this thing, you would find the stream flowed way down into here.

In fact, this shows the amount of water right here. This green figure shows the amount of water available for stream flow in this general area.

The water you are getting for stream flow is that water that occurs way up on the head waters in this watershed, and is merely trickling down here.

In low years, it will affect it down there, so it will affect it down here some way. (Indicating on chart.)

Q. May I ask this question, then. If we take this basin that we have got shown here, and let us [223] assume we have in the month of May no rain at all up above in the watershed, or anywhere, to feed the stream. And at this point you have no input at all, the upper end at the Bagdad sump, but the hydrostatic pressure continues to feed out water at the lower lip, which results in a dropping of the table here as it raises this water out. Then if we have a flood that comes down the first of June, and lasts a day, a summer rain that flashes over the top of the surface, that would bring this hydrostatic head back up to full capacity?

(Testimony of Herbert C. Fletcher.)

A. I would say it wouldn't, no. There has been too much time elapsed. Dr. Thiele said sixty feet a year, and I think that figure is high.

Q. You mean it is high for the amount of progress water would make underground?

A. Yes.

Q. With relation to studies and scientific information on the matter, is there any generally accepted rate of movement? Of course, I realize it is in relationship to slope, is it not?

A. It isn't only relationship of slope. He used the figure ten thousand, which is a very conservative figure, I think.

There is its relationship of sedimentation. There is the relationship of porosity and [224] surface tension.

There are, oh, every so many different factors that come in there, when you start to talk about the amount of water, how fast this water is going to flow in this underground channel.

Q. Well, then, the water which is put in at the upper end at Bagdad, or which goes in, let me put it that way, from the standpoint of its coming out at the lower end, two or three miles down, it would be several years, perhaps, before it got there?

A. I would say in my examination of the channel—as I say, I only spent the day there, I didn't make any detailed examinations or borings, or anything like that, just from my experience in examining other channels throughout the southwest, and the type of material in there, I think Dr. Thiele's estimates were very conservative.

(Testimony of Herbert C. Fletcher.)

Q. That is with respect to the——

A. With respect to the movement, and so forth, through the channel.

Q. And to the amount of capacity?

A. That is right.

Q. Of the basin itself?

A. Of the basin itself.

The Court: We will suspend now until two [225] o'clock.

(Thereupon, a recess was taken until two o'clock p.m. of the same day.) [226]

* * *

Wednesday, March 10, 1954, Two P.M.

HERBERT C. FLETCHER

resumed the stand and testified further as follows:

Direct Examination
(Continued)

Mr. Wilmer: Will you read the last question, please?

(The record was read by the reporter as requested.)

By Mr. Wilmer:

Q. Going back again to this loss of water through transpiration and evaporation, as I understand it, Mr. Fletcher, the figure which you arrived at as the average loss is the potential [227] loss which would be there if the area was wet with enough water to

(Testimony of Herbert C. Fletcher.)
supply the vegetation, and to be available for transpiration and evaporation?

A. Essentially, yes. I think that—well, for example, if the stream flow remained this high the year round, clear over during this period, then the evapotranspiration rate would be this amount. But the stream doesn't flow. It drops off, and this figure rises (indicating on chart).

Q. Now, what would the, or is there a distinction, if I may put it that way, Mr. Fletcher, to be ascertained here because of the abrupt change in the rate of evapotranspiration, and also the rather abrupt wasting of the stream itself? Does that have any significance with respect to the fact that in your judgment, I believe, the amount Bagdad takes from the stream would play little part in the summer dryness there?

A. Well, I don't think it would play a particular part, because the fact that the stream is dropping off fast here, you have got a period of, oh, two or three weeks there, if I get your question correct.

Q. Yes.

A. It may vary back and forth there, though, but, you see, the stream flow comes down here [228] so abruptly, and cuts off in here. This is just one you keep in mind. Too, I think if this was plotted on a longtime average, I don't think you would find this coming clear up in here. At least it has been my experience in most other areas throughout the state. It never comes up that high.

It usually comes up about here. You will have occasions like the 1951 flood, and the flood of August

(Testimony of Herbert C. Fletcher.)

in 1950, which was pretty general over this whole area, that conventional type storm covers large areas.

Those floods would bring this up a little bit. This 1953, flood, we had a fair flood in 1953, if you recall. Generally, there isn't anywhere near enough stream flow in here to supply this need.

Q. Now, would you say there is—this may not be a fair question, but from your observation of the area itself, I mean by that, eliminating any facts or figures, or anything else other than your general experience and knowledge by reason of the long years you have been in this game, from a mere visual examination of the type of stream, the type of material it flows through, the type of vegetation which you saw there, and the known characteristics of western streams, would it be your opinion [229] that in the summertime there would be a very large loss of water from the basin through evaporation?

A. Oh, yes, definitely so. In fact, well, as I said before, depending on this supply. But if this supply remains up anywhere in through here, it is going to be this amount, or essentially that amount.

Q. And the fact that the stream diminishes very rapidly, and at a time when the loss rises very rapidly, means there is a very brief period of time during which the water Bagdad takes would have anything to do with the substantial flow of the stream downstream?

A. I think so, because it is just at this critical point right here. You have got two factors that are

(Testimony of Herbert C. Fletcher.)

working against you, actually. The factor of diminishing stream flow, and the factor of increasing evapotranspiration.

Q. Supposing that you were to, by adding a comparatively small amount of water to the over-all summer picture there, I believe you testified that that would immediately within a few years tend to bring the vegetation further up into the channel, and create a corresponding loss?

A. Yes, yes. As Dr. Thiele pointed out this morning, if that water table rises—any water that [230] you put back in here, no matter how small the amount, is going to push this back. That is going to push the vegetation back here, which is going to increase the, which is going to come nearer to this point.

With this amount of streamflow, the evapotranspiration is way down in here, because you don't have the water to evaporate. (Indicating on chart.)

Q. If you could actually put some kind of container over that area, and contain the evaporation to measure it, you wouldn't find that much evaporation because the water isn't there to evaporate?

A. That is right. If the streamflow would maintain its level up in here, you would come to this point here.

Q. With actual water loss?

A. With actual water loss.

Q. Now, in the study of the probable loss of evaporation——

(Testimony of Herbert C. Fletcher.)

A. Just let me further illustrate that point with this other chart I showed you this morning.

This chart here, for example.

You see this is what will actually happen if the water was available. Actually, this [231] is what we have. (Indicating on chart.)

Q. Did we mark this in evidence?

A. Yes. This is Exhibit AA.

Mr. Wilmer: Let us have it, then, will you?

We offer in evidence Defendant's Exhibit AA for identification.

The Witness: I didn't know whether it was in evidence.

The Clerk: Defendant's Exhibit AA in evidence.

(Said document was received in evidence and marked Defendant's Exhibit AA.)

Mr. Morgan: Could I have a look at it?

Mr. Wilmer: Surely. I am sorry.

Mr. Morgan: We object to this as having no relation whatsoever to the question at issue. This pertains to an entirely different acreage, entirely different location.

The Witness: That is the average of all the state.

Mr. Wilmer: Wait a minute.

The Witness That is the average for the State of Arizona.

Mr. Morgan: Everbody knows there is evaporation.

Mr. Wilmer: The purpose of this, if it [232]

(Testimony of Herbert C. Fletcher.)
please the Court, is to show that the more water you make available, the more is used.

The Court: The more evaporation there is.

The Witness: The more you have available, the more that is going to be lost.

Mr. Morgan: There can't be any question about that either.

Mr. Wilmer: This is the relationship with transpiration from plants.

Q. (By Mr. Wilmer): I believe that is correct, is it not? A. Yes.

Q. And the solid curve demonstrates the fact that when your plants are growing and transpiring water, if there is ample water available, they will use it far greater than the amount they would use if it were not available?

A. As I said this morning, you have the three kinds of plants, hydrophytes, phreatophytes, and zarophrytic types, and even the zarophrytic types, they won't use as much as the hydrophytes or phreatophytes, but certainly they will use everything that is available, but they have to go dormant. That is why this is a potential line, and this is the actual line.

Q. All right, now, I would like to ask you [233] something further with respect to this basin there.

Do you know of any method by which it could be determined the amount of water which would be required to pass the Bagdad sump to get a certain net amount of water at the Zannaras point of diversion?

A. Well, from a practical standpoint, no.

(Testimony of Herbert C. Fletcher.)

Q. Tell us why?

A. The reason why you can't is because your streamflow is going to change, your vegetation cover is going to increase, and you have got to have ways of measuring all that.

You could measure the inflow into the basin and the outflow by years, but I don't think that would give you the picture, because you would have to keep measuring. And also your temperature changes and your humidity changes are all shown on this curve here, which wouldn't make it practical. You couldn't from a practical standpoint actually measure it.

I don't think you can say—I won't say it is impossible to do it, because it would be possible, but from a practical standpoint I don't think it would.

Q. Well, the amount of water which would be required to be put into the basin would vary in [234] relationship to temperature, would it not?

A. Temperature and precipitation.

Q. And humidity?

A. And humidity. The amount of vegetation cover.

Q. I believe it was your observation that the flood of 1951 fairly well denuded a substantial part of the smaller growths in the basin, which are not yet restored?

A. That is my observation. That is the way it appeared to me.

If you will examine the channel, now, there is quite a dense growth of willows occurring through this area here, young sprouts about this high that

(Testimony of Herbert C. Fletcher.)

have come up, I imagine, in the last couple of years.

In addition, down in this area, which is where most of your vegetation is, your bigger trees, and things of that type, which is an indication that this is where most of your water is, that is, the water remains here longer than it does up here, actually. (Witness indicates on Exhibit.)

Q. That would take almost a daily or weekly calculation, plus a survey of the area for growths of new vegetation, and larger vegetation, at least several times a year? [235]

A. Oh, yes. You would have to do that, more than that.

For example, in the Safford Valley when we measured the growth of the vegetation in Safford Valley, the U.S.G.S., they had these tanks they measured in tanks. They took tanks, and weighed those tanks.

I have forgotten the exact dimensions of them now, but they are about eight feet across, and they were about ten, twelve feet deep, and they were weighed daily for a period. I think the experiment ran for about six years.

Q. To determine the loss of water?

A. To determine the loss of the amount of water, amount of water loss from these phreatophyte type plants there, principally salt cedar and baccharis, which is a type of willow, and the cottonwood.

Q. Now, this figure that you have there, as to the

(Testimony of Herbert C. Fletcher.)

loss in evaporation over the basin, that represents an average over-all picture, is that the case?

A. That is right. Yes, you can't just tie it down to one particular location like this. This is an average, taking the average of precipitation for that particular weather station.

Q. For that area? [236] A. For that area.

Q. That is the reason, I take it, why you might go out there in July or August and find free running water when you theoretically wouldn't find it on the basis of a long-term investigation? A. Yes.

Mr. Wilmer: Cross-examine.

Mr. Morgan: Just take your seat, Mr. Fletcher.

Cross-Examination

By Mr. Morgan:

Q. I take it from your testimony that if the Bagdad and Zannara's had to depend merely upon the rainfall recharge from the Bagdad area, that there would be no living water there at all?

A. There would be very little, except during, possibly, as this chart that I show here, this little green area here, in along the latter part of February or March.

Q. Now, then, that means that the water comes from some other point, then, that is actually used?

A. Well, sure. Water, or most of the water that gets down in the desert originates in the higher elevations.

Q. From what source, do you know, does Bagdad [237] get its water at the sump? By that I

(Testimony of Herbert C. Fletcher.)
mean, is it from the rainfall in and about Bagdad, or is it from some other point?

A. Well, I think that it is a storage of water from other points. There is no question about that, along that entire channel.

The water that occurs as living isn't the surface runoff. It is the water that gets down into the basins all the way along, and gradually seeps into the channels.

Q. In other words, I take it it would be your view, if you could cut off all the water that comes down the creek at the Bagdad intake there, the point of diversion, that there would be no stream, no living stream just from the rainfall around Bagdad?

A. I think that is essentially correct, yes.

Q. Do you have any idea how much water comes down to the Bagdad point?

A. No. That is the testimony given by Doctor Thiele. I have no measurements of it.

Q. And that testimony, I take it, was limited to the amount of water that was shown in the gauge, that went into the sump, is that correct, into the Bagdad sump?

A. I guess that is correct. [238]

Mr. Wilmer: I think the testimony was in the record that it is the water that was shown as flowing out of the Bagdad sump.

Q. (By Mr. Morgan): Now, if there was no interference of water in this creek at the Bagdad sump, and all the water from up above flowed down

(Testimony of Herbert C. Fletcher.)

past that sump, you wouldn't say, would you, that that wouldn't create a stream that would be a living stream, both in wet weather and dry weather?

A. Well, judging from the figures, the measurements of the water that is passing the sump, I would say that there certainly would be times of the year when there is a possibility that there wouldn't be any water flowing over this point here, because of the high evapotranspiration potential that you have there.

Q. What months in the year?

A. Well, I would say from along in, oh, somewhere between April and October. Those are the high evapotranspiration potential months.

Q. In other words, if the whole flow came down, there would be nothing crossing the Kingman Crossing, you say?

A. No, I didn't say that. I said it would depend here, of course, it would depend on how much [239] water falls up here, the years that it falls up here, but I said it is a possibility that there wouldn't be any.

Q. That is true. I believe that in the year 1903, when there was a great drought, the whole creek went dry, before your time?

A. There are other years, others that are closer to my time. In 1947 there was a pretty good drought in the southwest.

Q. Would it surprise you to know in the year 1947, and that, by the way, was before the Bagdad began their pumping operations at their present

(Testimony of Herbert C. Fletcher.)
point from the river, that water constantly ran the whole year down the channel?

Mr. Wilmer: If it please the Court, I object to this arguing with the witness.

The Witness: I don't know about that.

Mr. Wilmer: I object to the form of the question.

The Court: The witness probably wouldn't be surprised at anything.

Q. (By Mr. Morgan): Now, in your evaporation figures, I take it that those are based both on subsurface and on the actual surface flow?

A. Evaporation figures. Well, of course, the [240] subsurface flow is a factor, that is, how close the ground water table is to the surface definitely affects the evaporation.

Q. What portion of the evaporation do you allocate to the underground waters, and what portion to the surface flow?

A. I don't allocate any. That is, I have to figure my evapotranspiration, I have to assume that the water is available, whether it is from ground water or surface water.

Q. To what extent available?

A. To the extent that it sets this curve (indicating on Exhibit).

Q. How close to the surface would that water have to be so that it could be evaporated?

A. From an evaporation standpoint alone, I think that it would be two to three feet.

(Testimony of Herbert C. Fletcher.)

Q. Below that point, the water probably wouldn't evaporate, or be lost?

A. I don't think the loss is too great below that, no.

Q. Then in determining your losses by evaporation, you, insofar as the underground flow is concerned, you cover only two feet from the surface down, is that right?

A. Evaporation alone? [241]

Q. Yes. A. Yes.

Q. Is that correct?

A. That is essentially correct.

Q. Well, then, you must allocate something, then, to the surface flow?

A. No, I don't consider the surface flow. I am considering the water available on the ground surface.

Q. That is the water from around Bagdad?

A. No, nothing to do with Bagdad.

Q. Well, you said so far as underground——

A. While I am figuring this curve here, what I am saying is, as to the general vicinity of Bagdad, that is the general area.

Q. But you didn't take into consideration the real source of supply of this water further north, then, up in the mountains?

A. That is not what I am talking about. You are talking about spring flow, and I am talking about moisture, available soil moisture available for evaporation.

(Testimony of Herbert C. Fletcher.)

Q. Then you didn't consider this flow of water at any time that came down from above?

A. No, no.

Q. But yet you say if that flow was allowed to [242] flow through, it wouldn't come down uninterrupted?

A. Well, I am saying that it wouldn't, because the potential here is high enough that it would evaporate the water that comes through.

You are confining it to this one little area. I am not. I have to look at it in a broad standpoint to figure the evapotranspiration curve.

Q. Well, in evaporation, as I understand it, the percentage of evaporation would be rather constant, wouldn't it? A. Definitely not.

Q. Well, now, just a minute.

That is to say, if there was a lake of ten acres, and another lake of 100 acres in the same locality, the actual percentage of inches of evaporation in any one month would be in all probability the same, wouldn't it? A. No, it would not.

Q. Why not?

A. Because it would depend on the depths of those lakes, the wind currents over those lakes, and several other factors that it would depend on.

Q. All right. Assume that the lakes were of the same depth, but of a different diameter, and that there was the same wind conditions? [243]

A. You are assuming a hypothetical situation now?

(Testimony of Herbert C. Fletcher.)

Q. You are an expert, couldn't you answer that? I would like to be informed.

A. You know experts can inform you on some things, and attorneys have to inform you on others.

Q. It is a fact, isn't it, that the percentage of evaporation would be just the same?

A. Well, no. Well, if you say that the conditions are exactly the same, yes.

Q. Yes.

A. But you never have a condition like that in nature.

Q. All right. Bring this situation into consideration.

Suppose that instead of, oh, we will say a thousand acre feet of water, or we will say 100 acre feet of water coming down this creek constantly, there came down this creek a thousand acre feet of water constantly?

A. You better put it at a thousand, because I think these figures show a hundred acre feet would put it around in here.

Q. Just assume, so that you can answer this question, assume that instead of a hundred acre feet coming down here constantly, you assume that [244] there is a thousand acre feet coming down here constantly. That is the assumption you take.

A. Yes?

Q. And the percentage of evaporation, we will say, oh, to make it easy, 20 per cent.

In the case of the thousand acre feet, 20 per cent of the water would be gone by evaporation—I mean

(Testimony of Herbert C. Fletcher.)

100 acre feet, leaving 80 acre feet of water to come down, isn't that right? A. Well——

Q. Now, wait a minute. Whereas, if there was a thousand acre feet—I am using the same formula, 20 per cent, there would be a hundred acre feet of water coming down, is that right?

A. No; because your evapotranspiration rate is rising all the time during the summer months.

Q. But your percentage would have to be the same? A. No; percentages aren't the same.

Q. Why not?

A. Because this curve here will—if, say, the thousand acre feet would put it up here, that is the amount of water if there was a thousand acre feet going down, this would remain the same at this point, but at this point it would be different. (Witness indicates on Exhibit.) **[245]**

Q. Just take your seat now. Maybe I don't make myself clear.

But wouldn't the situation be just the same as in the case of two identical lakes or ponds under the same conditions, with different amounts of water in them, the percentage of evaporation in each case would be the same, wouldn't it?

A. Well, you are talking of free water surface now?

Q. Yes.

A. With a free water surface, yes.

Q. Well, the same would apply, of course, wouldn't it, to the underground flow?

A. No; it wouldn't.

(Testimony of Herbert C. Fletcher.)

Q. If the conditions were just the same?

A. If they were ideal, but you would never get that. You say the conditions are just the same. You can't show me two places anywhere that are exactly the same in nature.

Q. I think you are avoiding the question I asked you.

A. I am just trying to put it from a practical standpoint, from the standpoint you can't assume anything unnatural like that.

Q. Well, you do assume it in all your formulas, don't you? [246]

A. Oh, no, I don't. Of course, I don't.

Q. They are based on assumptions?

A. No——

Q. That a certain tree will take up so much water, and that under certain conditions there will be so much water evaporated?

A. Well, you are doing it on a measurement basis, not an assumption basis.

Q. Well, what difference does it make?

A. In one case you have a figure that is tangible. The other isn't tangible.

Q. It all depends. You can surely answer this question; whether or not water that is allowed to escape here comes down this creek depends largely on the quantity of water, doesn't it?

A. Surely.

Q. That is right? A. That is right.

Q. If you put a large amount of water in and

(Testimony of Herbert C. Fletcher.)
it escapes down this creek, it will flow a long distance, it won't be all taken up by——

A. If you put a thousand acre feet in, we will say?

Q. Or even less, maybe. Let us just get it down as large or small.

If you put a fairly large flow of water, [247] or let a fairly large flow of water escape, and it comes down this creek, and it is big enough, taking a percentage of evaporation into consideration, and the time in which it will evaporate, the slope, the speed of the water coming down, and so forth, that water actually will flow farther than a smaller amount of water, won't it?

A. You are thinking of a constant head, or just a head like from a flash flood?

Q. No; I am not thinking about a flash flood. I am thinking about a regular constant head of water coming down.

A. All right; I will say it would go through continuously.

Q. Go through continuously? A. Yes.

Q. And the larger the amount of water, I presume, naturally the more gets down, and the farther it would go?

A. Yes; above the evapotranspiration point.

Q. Yes. Then if you put a smaller amount of water down there, it might or might not go except to a certain distance?

A. I think you have to admit that, sure.

Q. You think that is right?

(Testimony of Herbert C. Fletcher.)

A. I think that is right. [248]

Q. Now, the evaporation of a surface stream depends largely on the width and the depth of that stream, doesn't it?

A. You are talking about surface flow, now?

Q. I said a surface stream.

A. When you say stream, I don't know whether you mean the stream channel, or the flow of water.

Q. I mean the regular ordinary channel that carries the water.

A. You are talking about the water, now, and not the channel?

Q. Yes.

A. That is what I want to know. Okay.

Q. Now, isn't it a fact that the width of the channel of water, or the bed, whatever you want to call it, of water, and the depth of that water governs to a certain extent the evaporation?

A. Sure. The more you spread that water out the more evaporation there is.

Q. Yes, sir. Did you go over all this course that is involved?

A. I went up and down the channel. I didn't follow all up and down the living channel.

Q. Did you go to the Zannaras' point of diversion? A. Yes. [249]

Q. How far down did you go?

A. We went down here to this crossing.

Q. The Kingman Crossing? A. Yes.

Q. Did you observe the water channel? Let us

(Testimony of Herbert C. Fletcher.)

call it the water channel, so there will be no misunderstanding.

A. Yes. Only with the water in it.

Q. With the water in it, yes.

Mr. Wilmer: That is the surface water?

Q. (By Mr. Morgan): Could you give the Court any idea at the time you were there, which I think was Monday, how much water was flowing on the surface?

A. I haven't any idea how much was.

Q. You are an expert on those things. Couldn't you give us just an opinion?

A. You can't say, just to look at a stream of water, you can't just say how much water is flowing down there. That depends on the speed of the water, the depth of the water, the coefficient of friction between your rocks, how many rocks you have sticking out.

I couldn't answer that.

Q. Let us get it this way. From the point of the Bagdad diversion down to the Kingman [250] Crossing, if you observed that country, there is no feed of any kind or character going into this basin?

A. There is another side stream coming in.

Q. Except Boulder Creek?

A. That was the only surface water we saw coming in. I think there is a possibility, I think there is possibly some underground water coming into it. I don't know.

Q. I am talking about the surface now.

(Testimony of Herbert C. Fletcher.)

A. There was some water coming down Boulder Creek.

Q. That is a small amount?

A. That is a small stream, yes.

Q. The large flow, the principal flow came down through or past the Bagdad point of diversion, did it not?

A. Well, as far as I observed, the water was running through the—the whole diversion, the main channel runs right through it.

Q. You saw the sump there? A. Yes.

Q. Was that water running out of the sump down to the creek?

A. Yes, I believe it was.

Q. Did you happen to look at the gauge reading to determine the amount of water running at [251] that time?

A. No; I didn't take gauge readings.

Q. That sump is about 15 feet deep?

A. I don't know.

Q. Was there any water running around the sump at that time, or was it all running through the sump and down through the channel?

A. It was running down through the channel.

Q. All of it? A. As far as I could tell.

Q. There was no other surface streams alongside the sump that you saw there carrying water?

A. Not that I observed.

Q. Now, then, can you tell us the width of that water, and approximately the depth of that water as it ran out of the sump?

(Testimony of Herbert C. Fletcher.)

A. Oh, I would say it was between 75 and a hundred feet wide, something like that.

Q. As it ran out of the sump?

A. It was quite a channel. It is twice as wide as this room.

Q. We will say as it ran out of the lip of the sump.

A. I didn't see any lip of the sump there.

Q. The lower part of the sump?

A. It just runs out into the main channel, [252] the part that I observed.

Q. How wide was it there?

A. Well, I told you.

Q. You said the width of this room?

A. I said at least twice as wide as this room.

Q. That would be about 40 or 50 feet?

A. I would say the stream part was at least that.

Q. How deep was the water at that point?

A. That I didn't measure.

Q. Well, you observed the water?

A. No; I was not particularly concerned with that. I was concerned, my examination was concerned with looking at the vegetation conditions.

Q. You knew that flow of water continued right past the Kingman Crossing, and on down to what they call the Box Canyon?

A. No; I was not aware of that at the time I was there.

Q. You don't know about that?

A. My examination was to examine principally the vegetation character of the stream channel.

(Testimony of Herbert C. Fletcher.)

Q. Well, in the chart which I believe you assisted in preparing, or did prepare——

A. I prepared the evapotranspiration chart.

Q. Is it a fact that this chart shows that in [253] November, that is, in the month of November, now, from year to year in the month of November, that there would be water coming down the creek, more water than was being used up?

A. As far as this particular year is concerned, yes.

Q. This is intended as an average year, wasn't it?

A. No; the stream flow on there is one year, 1953. The evapotranspiration is an average.

You have two curves. This might be a little confusing to the Court. This curve is on an average. These curves are for the year 1953 (indicating).

Q. I see.

A. You see, I superimposed my curves, the curves I worked up from the other chart onto this.

Q. You don't know, then, what the situation would be in 1950, 1951, and 1952?

A. No; I would have to chart that. That would have to be charted. But I assumed that——

Q. I think we have in evidence here the rainfall record for 1953, don't we? And also the rainfall record in 1950 in the Bagdad area, for the months of October and November, 1950, and December, [254] 1950?

Now, from looking at that record, and assuming that Bagdad, we are talking about, pumped the same

(Testimony of Herbert C. Fletcher.)

amount of water they are pumping now, would you say whether or not there might be water running down the creek?

A. Well, I can say this, that there might be water running down the creek in 1950, because in August of 1950 I notice that you had 3.99 inches of precipitation, which is enough up in the upper part of the watershed that you would still have some of that draining out.

Q. You think, then, in the months of November, we will say, and October, there would be water down there?

A. I think there is a possibility, it is very probable, because if you will notice the stream flow record, or the precipitation records, which I don't know whether you have analyzed here or not, but the month of July is next to the highest, the month of July for 1950 is next to the highest month that you have on record.

Q. Well, presume now, to answer this question, if the records actually show that during all of the month of November, and up until at least the 23rd of November, there was no flowing water of any kind or character down at least as far as the Zannaras' [255] point of diversion, would you be able to give an estimate as to that in view of the chart you are looking at?

A. Those are conditions that are difficult to define, as to the precipitation record, but I am just basing my conclusions on the precipitation record itself.

(Testimony of Herbert C. Fletcher.)

Q. Do you have a ten-year chart somewhere?

A. For what? Precipitation?

This is an average for precipitation here.

Q. Does that include evaporation?

A. This is the evaporation here. (Witness indicates on Exhibit.)

Q. It includes both then. Looking at that chart, could you tell whether or not in 1950 there should have been water running down through here?

A. In November?

Q. Yes. A. I would say that there was not.

Q. That there was not?

A. I doubt if there would be over a long period of time.

Q. That is on the assumption, of course, that the water was being used?

A. No; I am saying it wouldn't have reached the [256] Bagdad sump.

Q. The Bagdad sump?

A. Of course not, because you haven't satisfied the soil moisture deficit up above, and the average precipitation in November doesn't——

Q. I thought we agreed on that, that so far as the Bagdad sump is concerned, it doesn't depend upon the Bagdad rainfall at all, but on rainfall farther north, isn't that right?

A. I am saying this: You asked me about stream flow now. You asked me a question about stream flow, and that is the one I answered you. I didn't answer your question about precipitation.

Q. I see your point. I think we are agreed on

(Testimony of Herbert C. Fletcher.)

that, that in no year, in no year would there be sufficient water, if the charge of the creek depended only on the Bagdad area upflow down the creek regularly, isn't that right?

A. No; I would say there might be a little in the winter period.

Q. Or when there is a big rainfall for awhile?

A. Or a flood.

Q. Or a flood. But ordinarily this stream depends wholly upon water that has its source, say, above that?

A. Essentially, yes. But, you see, you were [257] questioning me about stream flow, and you were talking about precipitation.

But if you will examine these records here, as far as the precipitation is concerned, you will notice that the months of August in 1950, and the months of 1946, which were two periods we had the highest precipitation on record in July, or in August, I should say—no; wait a minute. The one is in July, and the other is in August.

This is the highest one you have—no, in 1934 you have another one. That is about as high. So you see that precipitation can carry over, which I testified this morning, that that takes a month or two to get down from some of these lower elevations.

Q. Yes, sir. Would you be able to tell us from what source this basin is really filled with underground water?

A. Well, I think the major source is from the higher elevations.

(Testimony of Herbert C. Fletcher.)

Q. Yes. It is water that either escapes from the Bagdad sump—— A. No, no.

Q. Or gets around it in some way?

A. Well, I don't think that particularly. I think some periods of the year there is more water [258] there than the Bagdad sump would ever take.

Q. That is what I mean. It comes past the Bagdad sump?

A. Sure. There are periods of the year that it does.

Q. I take it for granted you made no finding as to whether or not there was any subterranean flow, or any underground flow at the point where the Bagdad has its point of diversion?

A. No; as I say, I didn't examine, I haven't examined the subsurface flow.

Q. You know that the bedrock comes to the surface at that particular point? You saw that, I suppose?

A. No; I didn't observe the bedrock coming to the surface there.

Q. Well, if the bedrock does come to the surface at that point, and all of the surface flow comes up to the Bagdad sump, you wouldn't be able to say, then, that there was any underflow?

A. If the case is such that somewhere up in here there is bedrock outcropping, I guess that is what this indicates here. I don't know. I am not familiar with that.

If you had something to force all the water over a bedrock point, something like this, [259] then you

(Testimony of Herbert C. Fletcher.)
would assume that as that water—of course, as soon as that water goes over that point, you know how water acts when you run it over a sieve?

Q. Yes, sir.

A. All right, that is what would happen, when you run it over the gravels.

Q. Now, assume——

A. Of course, if you are putting it that the bedrock is right there above the sump, I didn't observe that.

Q. Assume for this question that beginning about the month of May since the year 1948, the Bagdad people have used all of the water that came into the sump from the north during the dry seasons, that is, exclusive of flash floods? You understand? A. Yes.

Q. What effect over a period of months would that have on this underground water basin shown on this plat, Defendant's Exhibit N?

A. Well, I think if they used all of the water down in this point here, you are talking about this 200 acre feet now? You say there is 200 acre feet coming into the sump?

Q. Yes. [260] A. And they used it all?

Q. Yes.

A. Well, I think that would merely dry up this part of the basin. I don't know whether that would carry clear on down here or not.

Q. How long would it take to dry up the basin, do you figure?

A. That is a question I couldn't answer.

(Testimony of Herbert C. Fletcher.)

Q. Well, would it be substantially dried up during one season, say, over a period of five months?

A. No; I don't think it would.

Q. But it did tend from year to year to reduce it?

A. You see, the thing that occurs—I think Doctor Thiele brought it out this morning, as you reduce the hydrostatic head above, you reduce the speed that this water travels through here.

Consequently, as you get down toward this end of the basin, the water is going to go out much more slowly than it would if this hydrostatic head was——

Q. I think we understand that.

A. Of course, my feeling is that this is the area that shows there has been water, by the vegetation, that the water has remained close to the surface all the time right there. [261]

Q. There is some still down there?

A. And I think there is enough charging at this time of the year to recharge this back, because of the hydrostatic head that is put on.

Q. Referring back to this creek again as it runs through the yellow section portrayed in this map.

With reference to the boundaries of the yellow section, where does the creek run, that is, the surface water?

A. It meanders back and forth across in its channel.

Q. Does it generally run in the middle of the channel, substantially?

(Testimony of Herbert C. Fletcher.)

A. No; I don't think so. Let's see. Let's examine it. I presume this is the channel here?

Q. Yes. A. Right here.

Q. Some places it runs to one side, and some the other, is that correct?

A. That is right, from this picture.

Q. Now, it does run down the lowest point through this basin, doesn't it, along the lowest point?

A. I wouldn't say it absolutely had to, no.

Q. Well, you wouldn't say it was like the [262] Mississippi River, it would run up?

A. Yes; I think it would run up like the Mississippi River. It is the same kind of river. It carries sediment. This stream will meander here. The flood may come down and leave this part lower than the other.

Q. Isn't it a fact that, generally speaking, down through that territory that the land——

A. The stream is lower than the general slope?

Q. Yes.

A. You mean the stream channel is lower than this part here?

Q. Yes; generally sloping up on this side?

A. Yes; I think it would be two or three feet lower, something like that.

Q. Yes.

A. I don't think there is any depth. You would almost expect a little of that. That is only normal.

Q. Were you in the Courtroom today when your colleague, Doctor Thiele, testified to the amount of

(Testimony of Herbert C. Fletcher.)

underground water below the Kingman Crossing, and up to the Zannaras' point of diversion?

A. You mean yesterday?

Q. Well, I think today he testified to it, in which he stated, as I recall it, 150 acre feet of water from the underground water? [263]

A. I think I remember something like that.

Q. From Kingman Crossing to the Zannaras' point of diversion? Do you remember that testimony? A. I remember something of that.

Q. And he testified that the evaporation, that is, for a year, if there was that much water for a year, would amount to 250 acre feet. Do you remember that testimony?

A. Was it 250? I have forgotten just the exact figures myself.

Q. Yes; I took it down. Do you remember that testimony?

A. I was not paying much attention to that.

Q. Well, assume that he so testified. I wonder if you as an expert could explain where the Doctor got that additional 100 acre feet——

Mr. Wilmer: If the Court please, I object to counsel misquoting the testimony. The doctor testified to no such thing at all. He said there was 150 storage water——

The Court: Call the Doctor back if you want it. He is here.

Mr. Morgan: Doctor, did you testify——

The Court: Finish with this witness, first.

(Testimony of Herbert C. Fletcher.)

Mr. Morgan: I haven't finished with this witness. [264]

The Court: Finish him first.

Q. (By Mr. Morgan): Assuming that he did so testify, could you explain where he got that additional 100 acre feet?

Mr. Wilmer: I object.

The Court: You don't have to answer.

Q. (By Mr. Morgan): Now, then, the Doctor testified that it would be possible to put an underground tank of some kind, perforated tank, I think he said, across the creek at the Zannaras' point of diversion, and that ample water could be secured from the underground waters for the Zannaras Mill purposes. Did you hear that testimony?

A. No; I don't remember hearing anything about that part.

Q. Well, if he so testified, you, as an expert, and we concede you are, of course, could you tell us where would the water come from if there was only 150 acre feet going down in a year, and the evaporation amounted to 250 acre feet?

Mr. Wilmer: If it please the Court, there has been no such testimony. I don't know why counsel is wasting our time with a lot of stuff that doesn't have anything to do with this.

The Court: Yes. You can argue this with [265] the Court when the time comes. You don't have to argue with the witnesses.

Mr. Morgan: All right.

The Court: Is that all, now?

(Testimony of Herbert C. Fletcher.)

Mr. Morgan: Oh, yes; while you are on the stand, Mr. Fletcher:

Q. (By Mr. Morgan): Are you familiar with the tailings lake of the Bagdad Copper?

A. Just as I casually went by it.

Q. I presume you saw it, of course, from going by it, and also probably on this airplane trip you took? A. Yes; I saw it from the air.

Q. You know, of course, what the rate of evaporation would be under your formula in that section?

A. Yes. You mean evaporation now. You are talking about this figure here, I presume? It goes up to 74—well, it goes up to thirteen, thirty-two hundredths, thirteen forty-five hundredths inches per month.

Q. What I want to find out is what would be the yearly evaporation from that lake at that altitude? How much a month, or how many inches for a year would you believe that would be evaporated off?

A. Well, the total evaporation for that area, I [266] believe, is 74 inches, wasn't it, free water surface? If you are converting that, you have to multiply that by 1.3, reduce it by 1.3, which is the Geological Survey figures for reducing it to free water figures. Of course, that would make a difference in the depth of that lake.

Q. Assume the lake is ten feet deep.

A. All over?

Q. That is the average depth, it has an average depth of ten feet, and that the evaporation rate would be 75 inches a year, could you tell us how

(Testimony of Herbert C. Fletcher.)
much water in gallons or acre feet would be lost in that way?

A. I think you could figure that. An acre foot is equal to how much water, in gallons?

Q. An acre foot is equal to—I think I have got it.

A. You want to transpose it to gallons. If you want to leave the inches of water, 74 inches is a little over six feet of water. When you transpose it to gallons, it is 382, something like that, gallons in an acre foot.

Q. Three hundred twenty-six thousand would be the closest? A. That is good enough.

Q. That would amount to something like [267] two hundred thousand. You got the area, 100 acres surface, ten feet deep?

A. I am talking about one acre—I think in the testimony we have that there was 74 inches of water evaporated off of a free water surface, that is, in square inches.

When you transpose that into acre feet, why, that would be six acre feet from one acre, and if you want to multiply it by a hundred, that would be six hundred.

Q. Six hundred acre feet. And to get it into gallons, you would multiply that to make it an even number, by 326 thousand? A. Yes.

Q. It would be something around 200 million gallons? A. Somewhere near that.

Mr. Morgan: I believe that is all.

Mr. Wilmer: I have a few questions, your Honor.

(Testimony of Herbert C. Fletcher.)

The Court: We will have our afternoon recess.

(Recess.)

The Court: You may proceed. [268]

Redirect Examination

By Mr. Wilmer:

Q. Mr. Fletcher, I am handing you Defendant's Exhibit AB for identification.

I believe you stated that was a study or a chart which you prepared from the U.S.G.S. and the Weather Bureau records, in accordance with the accepted method of preparing those studies, related to the Bagdad area? A. That is correct.

Mr. Wilmer: We offer Defendant's Exhibit AB for identification in evidence.

Mr. Morgan: No objection.

The Clerk: Defendant's Exhibit AB in evidence.

(Said document was received in evidence and marked as Defendant's Exhibit AB.)

Mr. Wilmer: Just a couple more question.

Q. (By Mr. Wilmer): The probable loss from evaporation as reflected by the portion of the chart you prepared, I believe you stated related generally to the Bagdad area?

A. Yes. That is the one just handed me.

Q. Yes. And the blue line on the evidence, [269] which is Exhibit Y in evidence, if that loss were limited, the potential was limited solely to the area of the creek basin, by reason of the lower elevation,

(Testimony of Herbert C. Fletcher.)

and the large amount of trees and similar vegetation, in your opinion, would that loss be higher or lower, the potential?

A. You mean if it was just confined to this particular area here?

Q. Yes. A. Oh, I think it would be higher.

Q. Substantially?

A. Yes; I think it would be substantially higher, because you have a different type of vegetation.

Q. Now, counsel asked you with respect to loss by evaporation from a surface. And I believe you stated that below two feet, or in that neighborhood, the evaporation loss should not be large?

A. That is correct.

Q. Now, if you would take that similar—or take a surface for purposes of illustration, say, an acre, and over that acre you have a reasonably substantial vegetation growth, including mesquite, willows, and similar growth which has a moisture supply in the gravels below it, but below two feet; in your opinion, how would the loss, water loss [270] from those gravels compare from transpiration as against a free water surface?

A. Well, of course, that would make some difference as to the density of the vegetation.

But I would say for purposes of developing this curve, we use a three-tenths density figure, which if you look straight down, about three-tenths of the area is covered with vegetation.

If you say that, if you assume, well, for example, in the Safford area where the vegetation is closer to

(Testimony of Herbert C. Fletcher.)

an eight-tenths density, I think the transpiration from trees of, oh, moderate size, say, ten, fifteen feet, exceeds free water surface.

Q. Well, relating it back to the area as you observed it in the basin, and assuming that you have a type of situation there that has an average ten-foot gravel and sand basin, with a three-tenths average growth of the type you observed, how would the loss over that basin from transpiration compare with loss from a free water surface?

A. Well, on a three-tenths, in an area like you have down here in this lower part of the basin down here, it surely indicates to me that this area has ample water most of the year, all of the year, for that matter. [271]

I think it probably, oh, probably comes pretty close to, on our three-tenths density basis, would probably come, depending on the size of those trees, and all, that would probably exceed the free water surface.

Q. Then as you move up the basin toward the Bagdad sump where the vegetation becomes less heavy, and not as large, I take it it would tend to fall below the free water? A. That is right.

Q. And that is the reason you have this curve of the evapotranspiration?

A. Yes; that is one of the things we have to take into consideration.

Q. Now, counsel asked you some questions with respect to whether, if you put more water in the

(Testimony of Herbert C. Fletcher.)
top end of the basin, you get more water out the bottom end of the basin.

Would you tell me what would be required as to the basin being fully carrying its capacity?

Let us put it this way. Would that occur until the amount of water flowing at the upper end equalled the evapotranspiration loss, that you would get as much out of the bottom as you would put in at the top?

A. You never get as much out of the bottom as [272] you put in the top until the evapo—until this potential is reached, if I get your question.

Q. Yes; that is right. If the evapotranspiration potential of the basin area is 100 acre feet, and you put in 100 acre feet, you get none out of the bottom?

A. That is correct.

Q. If you put in ten acre feet, you get out probably ten acre feet?

A. Somewhere near ten acre feet.

Q. But until the amount of charge or supply at the upper end balances the evaportion and transpiration loss, and seepage, and so forth, the amount you put in at the upper end is immaterial as to getting any out at the lower end, until that balance has been reached, is that correct?

A. Yes. Well, I think that is amply shown here, if you analyze this chart, if you look at the chart, from what it says, because you are putting in here 200 acre feet, and the evaporation and transpiration is actually taken out around 86 acre feet.

Q. Until you reach that point, water at the upper

(Testimony of Herbert C. Fletcher.)

end is merely released for the purpose of evaporation and transpiration?

A. That is right. [273]

Q. One other question.

I was not clear when counsel asked you as to whether you took into any account the water flowing from above Bagdad in your conclusions, as to what the water loss was over the basin, and in the area. Actually, what you were determining was the amount of water which would be lost over the basin, assuming that there was that amount of water in the basin, is that right?

A. I have to assume that.

Q. So actually whether there was any water in the basin or not is immaterial to your study as to what would be lost if water was there?

A. Actually in the basin the water drops down here below three or four feet, as far as evaporation is concerned; then you are not going to have as high evaporation as if it was in, say, two or three feet within the surface, and in view of that, then, this total, actually the total amount that will be evaporated is going to drop down somewhere in here. As long as you maintained it up to this point, and then decrease it, it is going to come down in here somewhere. (Indicating on Exhibit.)

Mr. Wilmer: That is all. [274]

(Testimony of Herbert C. Fletcher.)

Recross-Examination

By Mr. Morgan:

Q. Mr. Fletcher, when you were up there last Monday, you did go down there as far as the Kingman Crossing? A. Yes; we did go down there.

Q. And you saw the water, the water flowing out of the sump, or by the sump, by the Bagdad intake, you saw that? A. Yes.

Q. You saw the water as it came down to the Kingman Crossing? A. Yes; I saw it.

Q. The water was running all the way down, wasn't it?

A. Well, sure. You are in this time of the year, right in here, in March. (Indicating.)

Q. But there is considerable evaporation, isn't there?

A. Not comparatively, no. Evaporation here is clear down in here.

Q. What would the rate be in March, what percentage? A. Oh, the rate is about 150.

Q. What do you mean by 150?

A. 150 acre feet a year. [275]

Q. But it did get down there, and was running at a pretty good volume?

A. That is a pretty fair sized stream running down here.

Q. Now, all streams, no matter whether they are large or small, of course, are susceptible to evaporation and transpiration if they have trees, isn't that

(Testimony of Herbert C. Fletcher.)
a fact? A. That is right.

Q. And yet they continue to run and run and run? A. I don't say that.

Q. Why is that?

A. You can't say that they continue to run and run and run, because they don't.

Q. What I mean is that they are what they call live streams, notwithstanding that they are subject to evaporation?

A. A good many of the streams that are live streams don't run the year round on the surface.

Q. That is true, especially out in the southwest, we know that. But you take a stream, we will say, back in the plains country, that water is subject to evaporation? A. That is right.

Q. And subject to transpiration, isn't it? [276]

A. That is correct.

Q. And yet the water runs hundreds of miles continuously? A. That is right.

Q. Now, why is that? Why isn't it all used up?

A. I think that chart I introduced there for Bagdad as evidence, shows that, but I will show you another chart that points it out a little further. I didn't make myself clear on that.

Well, take Alpine, for example. I won't show this if you would rather not.

Take Alpine, for example. Here is the evaporation transpiration curve. You notice the precipitation is high during the summer. It almost exceeds the evaporation transpiration curve.

Consequently, the soil moisture storage is more in

(Testimony of Herbert C. Fletcher.)

here compared to this, and you have all of this in here available for stream flow.

Consequently, your streams run longer from this area than they do in this area, which from this chart introduced in evidence only shows a very small point right there available for stream flow.

Mr. Wilmer: What point are you pointing out now?

The Witness: These two points here. (Indicating.) This point here, and this point here. [277]

Mr. Wilmer: This point on your—I think it is Exhibit AB?

The Witness: That is the soil moisture storage. You are putting water back in the soil that was taken out during this period by the vegetation.

Q. (By Mr. Morgan): Could you illustrate where that point might be on this plot, Exhibit N?

A. No, because this is a general area. This doesn't confine it to this particular end.

Mr. Morgan: That is all.

Mr. Wilmer: That is all.

(Witness excused.)

Mr. Wilmer: I would like to recall Doctor Thiele.

HEINRICH J. THIELE

recalled as a witness by the defendants, having been previously duly sworn, testified further as follows:

Further Direct Examination

By Mr. Wilmer:

Q. Doctor Thiele, I hope I am not confused as to what the testimony was, but I would like to be sure what your testimony is. [278]

With respect to the amount of water which in your opinion, on your calculations, is available below the Kingman Crossing, and to the Zannaras Mill, was your calculation based on the amount of water lying in that basin and available for withdrawal at the lower end, without regard to the stream flow?

Do you understand my question?

A. No; I don't think so.

Q. What I wanted to know is this: On your calculation, if we shut off the water at this point here (indicating on Exhibit)——

A. The stream flow?

Q. The stream flow at that point here, and at that moment measure the water in the basin from that point to the Zannaras Mill, what would be your calculation as to the amount of water in storage in that basin? A. One hundred fifty acre feet.

Q. Very well.

And applying the same tactics, if we shut off the water at this point, and at that moment measure the water from the Bagdad sump, or cut the water off to the Kingman Crossing, what amount of water would there then be stored in the [279] basin there?

(Testimony of Heinrich J. Thiele.)

A. Two thousand seven hundred acre feet.

Q. Did you attempt to testify as to the amount of water which in a year flowed down the stream at any given time, the full amount?

A. In 1953, 6,413 acre feet.

Q. By that I mean, Doctor, over the entire year?

A. Over the entire year.

Q. Do you have any way of calculating how much water moves in the entire stream bed—I don't mean underground, or anything else—I mean the entire amount of water?

A. In the stream bed, according to the gauge readings at the Bagdad station.

Q. Taking into account floods?

A. Only taking the gauge readings into account, 1953.

Q. What year are you talking about?

A. 1953.

Mr. Wilmer: That is all.

Mr. Morgan: Just a question, Doctor.

Cross-Examination

By Mr. Morgan:

Q. Didn't you state today in answer to counsel, and then in answer to my cross-examination, that the [280] portion of the stream below the Kingman Crossing, and up to Zannaras, according to your calculations, contained 150 acre feet of ground water in a year?

A. In a sheet 200 feet wide, 15 thousand feet long, and ten feet thick.

(Testimony of Heinrich J. Thiele.)

Q. That is for the year——

A. No; that is ground water storage.

Q. That is the storage?

A. That is the storage capacity.

Q. And your calculation was that water coming down this course would move at the rate of 60 feet, didn't you say?

A. I imagine that it could move like that.

Q. A year? A. In a year.

Q. Sixty feet a year. Then you also testified in answer to both questions of counsel and myself that the total evaporation loss in this section from the Kingman Crossing to the Zannaras point of diversion in a year would be 250 acre feet?

A. Yes; that is correct. We have in these 250 acre feet our take from the stream flow, with 6,400 acre feet, and the additional ground water storage of 150 acre feet.

Q. This is underground water you are talking about? [281]

A. Underground and surface water, both of them. The underground water and surface water, and the restorement of ground water by surface water.

Q. How could you store surface water?

A. The ground water that is evaporating is replaced by surface water again.

Q. I will confess I don't understand you, Doctor. We were talking about underground water. And you specifically stated, as I understand it——

A. Excuse me, sir. You cannot divide up ground

(Testimony of Heinrich J. Thiele.)

water and surface water in this area. You have surface water going into the ground. You have ground water rising out of the ground.

This is going in and out. All your subsurface and surface flow is one unit here.

Q. Well, in any event, there wouldn't at any time be over 150 thousand acre feet of both ground and storage—I mean underground and surface water in this area?

A. We have the surface water flow nearly ten months a year, according to the records, and only two months in the year we don't have a surface flow.

Q. I think it is seven months.

A. I asked you already before—this is a [282] scientific investigation I have done here, and I asked you before, do you have any gauge station readings of that area there?

You can answer in a scientific way only with scientific data, not with "seven months," or things like that.

You have to prove with exact data from the gauge station readings what is the actual flow.

Q. What point of this 150 acre feet in your judgment now represents underground water, and what part surface water?

Mr. Wilmer: He can't answer that.

The Witness: That is the storage capacity, as you stated yourself. The 150 acre feet is the storage capacity between Kingman Crossing and Zannaras' point of diversion.

(Testimony of Heinrich J. Thiele.)

Q. (By Mr. Morgan): Well, the stream itself wouldn't——

A. It is not the storage, because the stream doesn't given any storage capacity. The gravels and sands, they have a storage capacity, and we are talking about the storage capacity of these sediments.

Q. So it would be the underground waters you are talking about?

A. Yes; we are talking about the [283] underground, and of the surface water, because the underground water is replaced by surface water.

As you say, it is seven months of the year, but you surely couldn't prove to me that every year you had only seven months surface water flow.

Q. But during that period it would be 250 acre feet lost in evaporation?

A. From ground water and surface water.

Q. Some of the surface water would run below, wouldn't it?

A. In one year. Not in the period of seven months. In one year.

Q. In one year? A. In one year.

Mr. Morgan: I think that is all.

(Testimony of Heinrich J. Thiele.)

Redirect Examination

By Mr. Wilmer:

Q. Just a minute. I assume, Doctor, that the channel from the Kingman Crossing to the Zannaras Mill, from previous testimony, is pretty much the same as a container, is it not, it being a canyon-like formation, pretty much the same as if you put a trough down there with rock sides, is that right?

A. It is a trough with rock sides. [284]

Q. And then if you fill that trough with sands and gravels, it would hold a certain amount of water from the Kingman Crossing to the Zannaras' point of diversion? A. Yes, sir.

Q. And you are speaking at the point where it would be full and not running over there would be 150 acre feet of that?

A. Yes. And what is happening there, you have also a lot of trees, cottonwoods, and so forth, pumping out.

Q. I just want to establish that that is your testimony as to the storage capacity? A. Yes.

Q. And as that is lost by evaporation, the new water coming in keeps it filled? A. Yes, sir.

Mr. Wilmer: That is all.

Mr. Morgan: That is all.

(Witness excused.) [285]

ERNEST R. DICKIE

called as a witness for the defendants, having been first duly sworn, testified as follows:

Direct Examination

By Mr. Wilmer:

Q. Will you state your name, please, for the record? A. Ernest R. Dickie.

Q. What is your connection with the Bagdad Copper Corporation?

A. General Manager of the Bagdad Copper Corporation.

Q. How long have you held that position?

A. Ten and one-half years.

Q. You began at what time?

A. September 1st, 1944.

Q. How long have you been engaged in mining operations?

A. Well, I was born and raised in mines.

Q. How long have you been familiar with and engaged in operating mills, mills used for processing minerals?

A. I actually started to work in mills when I was sixteen.

Q. Since you were sixteen. What is your present age? [286] A. Fifty-two.

Q. Since that time, have you been entirely devoting your time, or devoting your entire time to mining matters?

A. The biggest portion of the time since I have been out of my own naturally has been with mining and mining matters.

(Testimony of Ernest R. Dickie.)

Q. Have you had occasion to operate many mills?

A. Yes, sir.

Q. Are you familiar with the mill that Mr. Zannaras has on his millsite?

A. Somewhat familiar, yes, sir.

Q. Over the past six or seven years, you have had some occasions to look at it, haven't you?

A. Yes, sir.

Q. I think it has been described in the record, so I will not go further with those questions that were asked in the previous hearing.

Can you tell me, Mr. Dickie, in the operation of a mill of the general size, characteristics, and capacity of that of Mr. Zannaras, if there is a recognized proportion of water which is required in proportion to the amount of ore put through the mill? A. Yes, sir.

Q. And what is that?

A. That depends, of course, on types of [287] materials that are to be milled; the type of processor; and in speaking of Mr. Zannaras' Mill, which is classified as gravity concentration, about the minimum amount of water that would be required to operate that mill would be three tons of water to one ton of ore, or 25 per cent density.

Q. You say there is some difference according to the type of ore, and similar matters.

How much variation do you find by reason of—what would be the maximum and what would be the minimum, by reason of the differences in the ore, and similar matters?

(Testimony of Ernest R. Dickie.)

A. Different mill men have different ideas, with regard to making the maximum recovery. And it would average, I would say, from three to five tons of water to one ton of ore.

Q. But your minimum requirement would be three tons of water to one ton of ore?

A. Yes, sir.

Q. Do you know when Bagdad first began pumping from its present point of diversion in Burro Creek? A. Yes, sir. Not the exact month.

Q. Well, approximately.

A. It was in late 1943.

Q. That was at the present point of diversion, with one pump? [288] A. Yes, sir.

Q. And what was the capacity of that pump, if you know?

A. Reading capacity, 750 gallons per minute.

Q. And that pumping was conducted until there was a second pump added, I believe, for carrying excess water when the stream was running?

A. Yes, sir.

Q. When was that installed?

A. 1951, during the year 1951.

Q. So that since late in 1943, Bagdad has been pumping from the stream at its present point with a 700 capacity gallon pump? A. Yes, sir.

Q. Mr. Dickie, do you have some pictures of the stream bed of Burro Creek below the point of diversion? A. Yes, sir. These are older ones here.

Mr. Wilmer: I am going to ask that these be marked in two groups.

(Testimony of Ernest R. Dickie.)

Mr. Morgan: I might say this testimony has all been before the Court. I don't know whether the Court wants it again.

The Court: Some of those have been marked.

Mr. Wilmer: Some of these have been. These have not. These are different [289] pictures.

I am putting in the additional pictures to not encumber the record, but because of the fact that the type of the stream and the vegetation seems to be of consequence.

Will you mark them as one exhibit, if you will?

The Clerk: Defendant's Exhibit AC for identification. And Defendant's Exhibit AD for identification.

(Said documents were marked as Defendant's Exhibits AC and AD for identification.)

Q. (By Mr. Wilmer): Showing you Defendant's Exhibit AC for identification, I believe you previously examined these, didn't you?

A. Yes, sir.

Q. To avoid having you look at them again?

A. Yes, sir.

Q. Are you familiar—you are familiar, of course, with the creek from the Bagdad sump to the Kingman Crossing? A. Yes, sir.

Q. These pictures marked Defendant's Exhibit AC for identification, are they generally [290] representative of the condition of that stream in the fall of 1951, with respect to vegetation growth and similar matters?

(Testimony of Ernest R. Dickie.)

A. All but this. This one was taken in 1953.

Mr. Wilmer: With respect to the second group which has been marked Defendant's Exhibit AD for identification, may I ask permission at this time to withdraw the one which Mr. Dickie identified as the 1953 picture, and put it with the ones that are 1953 and 1954?

The Court: You may.

Q. (By Mr. Wilmer): Referring to Defendant's Exhibit AD for identification, will you state whether those are representations of the condition of the creek bed in the fall of 1953 and this spring? Or what years they do cover?

A. Now, I have two pictures in this group that were taken in June, 1952.

The balance of the pictures are in the fall of 1953, and the winter and early part of this year, 1954.

Mr. Wilmer: May these two which he has identified as being taken in 1952 be identified by the fact there is written on the back of them "June 12th, 1952"? [291]

Q. (By Mr. Wilmer): That is correct?

A. That is correct.

Mr. Wilmer: We offer the two exhibits, AD and AC for identification in evidence.

Do you want to look at those, Mr. Morgan?

Mr. Morgan: I think we ought to look at them.

These are down at the Kingman Crossing, all of them?

Mr. Wilmer: He can identify them if you want

(Testimony of Ernest R. Dickie.)

him to. I haven't attempted to. They are generally of the creek, not of the Kingman Crossing.

Mr. Morgan: We have no objection, as far as I can see.

The Clerk: Defendant's Exhibit AC in evidence.

(Said photographs were received in evidence and marked as a group exhibit, Defendant's Exhibit AC.)

Mr. Morgan: Could I ask a question on voir dire?

The Court: Yes.

Q. (By Mr. Morgan): Are those all below the Bagdad point? [292] A. Yes, sir.

Q. How far down do they go?

A. Well, the most of them are within the first half, and lie below the Bagdad. There is one in that group, though, that was taken down at Kingman Crossing.

Mr. Morgan: All right.

Q. (By Mr. Wilmer): These are representative of the growth there?

A. In that group they are all below.

Q. I say, these are representative of the type of vegetation and gravel beds immediately below the Bagdad sump? A. That is right.

Q. And do not reflect the growth at the lower end? A. No, sir.

The Clerk: Defendant's Exhibit AD in evidence.

(Said photographs were received in evidence and marked Defendant's Exhibit AD.)

(Testimony of Ernest R. Dickie.)

Q. (By Mr. Wilmer): Now, in a milling operation, Mr. Dickie, in the general Kingman area, I mean, the general Bagdad [293] area which includes the location of the Zannaras Mill, is there any particular advantage in milling at any particular time of the year?

A. Of milling in any particular time of the year?

Q. Yes.

A. No. Honestly, I wouldn't say that there would be. The only thing I could think of was in here, when you had ore available, and when you had water available.

Q. I am speaking with respect to the seasons of the year. Is there any advantage in milling——

A. No, sir.

Q. In the summertime, in distinction to the following spring? A. No, sir.

Mr. Wilmer: Cross-examine.

Cross-Examination

By Mr. Morgan:

Q. You testified fully in this case before?

A. Yes, sir.

Q. You testified fully before? A. Yes, sir.

Q. Those pictures which you have introduced in evidence in this case, do those pictures show the [294] condition with respect to vegetation, about as they were, oh, several years ago?

A. I didn't quite get you, sir.

Q. I say, do they show the conditions as to vege-

(Testimony of Ernest R. Dickie.)

tation along this stream as they did several years ago?

A. No. In the first place, these pictures weren't taken with the idea of showing vegetation. Really, it was to show the condition of the stream and the stream bed. However, naturally, you do have several photographs there that show the condition as of the last year or so, in reference to vegetation.

In 1951 we had, as you know, several high water floods, you might say, going down the creek, and it pretty much cleaned all the smaller brush out, which has grown up again now.

Q. I notice in these pictures introduced in evidence that in some of the pictures, at least, the stream itself has decided banks on either side?

A. Yes, sir.

Q. And is that true generally all the way down to the Kingman Crossing?

A. Well, it depends on what you refer to as banks, how much of a bank.

Q. Oh, I mean two, or three, or four feet, [295] sometimes?

A. Yes, sir. I would say that the channel that the live water is flowing in now would average three or four foot below the surrounding surface of the valley.

Q. Yes?

A. In most cases, other than down toward the Kingman Crossing.

Q. That is where it hits the ground and spreads out? A. Yes, sir.

(Testimony of Ernest R. Dickie.)

Q. When were these pictures taken?

A. They are all dated—two of them taken in June, 1952. The balance of them taken, in that one group, during the fall of 1953, and up to now, this year.

Q. In any event, they were taken before the streams stop running? A. Sir?

Q. They were taken before the streams stop running?

A. Well, that depends on how you are putting the question.

When you say the streams stop running, when? What year? This year? Last year?

Q. No, at the time the pictures were taken. [295-A]

A. No. I don't quite follow you.

Q. Don't the pictures all show running water?

A. That is right.

Q. They were taken, then, while the creek was actually running, carrying running water below——

A. Below the diversion point of Bagdad, yes. That is the idea of taking those pictures.

Q. There are times, of course, when there is no water running in the stream below?

A. Below the diversion point right out of the pump, but within half a mile below, the water is running again, and that is what these pictures are to show.

Q. It comes up and drops again?

A. Yes, into the gravel.

(Testimony of Ernest R. Dickie.)

Q. And it appears again at the Kingman Crossing?

A. With the exception of a few holes along the creek.

Q. As far as you know, there always has been water at the Kingman Crossing?

A. Some water, yes, sir.

Q. Even during your pumping operations?

A. I never have seen it dry. I have been up and down there and across there many a time.

Q. What the situation is below that, do you know? [296]

A. Below the Kingman Crossing?

Q. Yes.

A. At any time that I have been below the Kingman Crossing at Zannaras' point of diversion, I have not seen it dry, but evidence here by pictures was introduced at one trial, I mean at one hearing, showing that it evidently was dry, but I didn't see it.

Q. Oh, yes. You have two pumps now, you say, down at your mill? A. Yes, sir.

Q. In the dry season, I take it only one of those pumps is used? A. That is right, sir.

Q. You get all your water from up above that comes down to the sump, don't you?

I mean, your source of water is a flow down the creek? A. Down Burro Creek?

Q. Yes, Burro Creek. A. Yes.

Q. That you catch in your sump, and you pump it from that pump up to—— A. Bagdad.

Q. Yes. Now, in certain seasons of the year, there

(Testimony of Ernest R. Dickie.)

is an amount of water that greatly exceeds [297] your pumping capacity?

A. That greatly exceeds, you say?

Q. Your pumping capacity. That is, there is a big flow down the creek? A. Yes, sir, correct.

Q. And that flow is when, during what months, generally speaking, does that flow run down the creek?

A. Well, during the late winter and early spring months there is—generally, the flow is a good deal larger than the amount that is required by Bagdad.

Q. Yes. And then in the summer months, in the dry months sometimes that flow is greatly lessened, and you use all of the water that runs into your sump?

A. All of the surface water. There have been times when we do use all of the surface water that would flow into our pump.

Q. Yes. That is in, generally speaking, what months?

A. Oh, it varies from year to year. I remember one year when it was late in May. Another year June. It seems to me it was in August one time. There was a shortage of water, and October another year was short. But that isn't true every year. [298]

Q. In the wintertime, when there is a large supply of water, I take it you use the other pump for the purpose of keeping your lake filled up, your tailings lake?

A. The idea of that is when there is water available running to waste, we do take on as much as we

(Testimony of Ernest R. Dickie.)

can pump, and the surplus of it is stored in our lake to carry us over dry season.

Q. That is used the year round, that lake is maintained the year round? A. Correct, sir.

Q. About what is the capacity of that lake in acres, if you know?

A. The surface area at this time, probably 100 acres.

Q. Some of it is very deep, I presume? And some is shallow? A. Correct, sir.

Q. And what would the average depth be?

A. I couldn't give you that figure. It would just be strictly an estimate. An estimate wouldn't be any good.

Q. To put it mildly, would it be around ten feet?

A. Yes, I would say it would be ten feet easy enough. [299]

Q. Possibly more than that. Then you keep in storage, I take it, at least a thousand acre feet of water?

A. Well, I would have to do a little calculating there, because the tailings are going into that same pond continuously at the same time, and that it does raise the level of the lake. I wouldn't want to answer the question whether we have got a thousand acre feet of water in there or not.

Q. Would you say approximately that?

A. I don't think I would even want to say approximately any figure. We know we have got quite a surplus of water, yes.

Q. If the lake were a thousand acres at the sur-

(Testimony of Ernest R. Dickie.)

face, and it average ten feet in depth, that would mean a thousand acre feet?

A. Correct. But here is the first thing. A big portion of that lake area tailing pond is tailings, not water, and when I said a hundred acres in area, I meant the whole tailing pond and water.

Q. Of course, the tailings also contain a lot of water, do they not?

A. Of course, there is no doubt but what they will hold moisture. [300]

Q. How many gallons of water would that be, a thousand acre feet? I believe you could arrive at that by multiplying it by 326 thousand?

A. Yes, somewhere in that neighborhood.

Q. Something over 500 million gallons, wouldn't it be? A. I expect. I haven't calculated it out.

Q. About 325 million. That is correct, is it not? You have quite a loss from that, then don't you, from evaporation?

A. Yes, we realize that there is quite a bit of loss by evaporation.

Q. Is there any method you could adopt——

A. Sir?

Q. Is there any method you could adopt up there that would save that water loss?

A. From evaporation?

Q. Yes. A. I don't know of one.

Q. Couldn't you use the filter system, the thickener system of saving water, as they do at many of the mines?

(Testimony of Ernest R. Dickie.)

A. That was used at Bagdad at one time, but we only recovered forty-four per cent of the water. And in the present method of sending the water out [301] in the pond, and taking into consideration the evaporation, we are saving 60 per cent of the water.

Q. On the other hand, you are losing about 75 per cent every year?

A. You are going to lose it off of thickeners just the same as by evaporation, only you don't have as big an area.

Q. You run the water back into tanks and thickeners, don't you?

A. We don't use any thickeners now.

Q. But you did when you used them?

A. In the beginning, yes, sir.

Q. I guess you are familiar with the Castle Dome operation, where they use the thickener system to save water from evaporation? A. I am.

Q. And other mines in this state?

A. Sure.

Q. It would be possible to save a good deal of water that way?

A. We wouldn't save water, no, sir, not over what we are doing.

Q. Not if you turn it back into the lake again?

A. Sir?

Q. It wouldn't save it if you turned it back into an open lake? [302]

A. Maybe you don't understand what the thickener does.

The thickener is a settling pond, you might say.

(Testimony of Ernest R. Dickie.)

Q. Yes.

A. And it has mechanical means in the bottom that settles the mud to one location, and that mud is pumped down forty-five to fifty per cent solids. That is about as much as you can possibly condense it, and when that is discharged, the balance of the water in that tailings is lost through evaporation, and also through the evaporation that is on the surface of the thickeners.

Q. Are you familiar with what is known as hydroseal pumps used in connection with thickeners?

A. I know what hydroseal pumps are. We use them.

Q. Are you familiar with this information they put out as to how to save water by using thickeners?

A. We have loads of that type of information.

Q. This is a very picture of your tailings pond, isn't it? A. Of our tailings pond?

Q. Yes. A. No, that is Castle Dome.

Q. Are you familiar with that? [303]

A. Yes, sir.

Q. They use the thickener system down there?

A. Yes, sir.

Q. Do you know what their recovery of water is?

A. Well, I have a report on it that it recovers— I don't just recollect, but their actual recovery was less than what we are getting.

Mr. Morgan: I think that is all, sir.

(Testimony of Ernest R. Dickie.)

Redirect Examination

By Mr. Wilmer:

Q. Ernest, I am going to show you an exhibit previously introduced in this case, Plaintiff's Exhibit Number One, which is a series of reports as to the gauge readings at Burro Creek.

Counsel asked you some questions with respect to the times of the year when water went by the Bagdad sump. These are the actual records of the amount of water discharged past the sump through these periods, is that correct? A. Yes, sir.

Q. So that the times when water was discharged past the sump, and the amount, is reflected by Plaintiff's Exhibit One in evidence in this case?

A. Correct, sir.

Mr. Wilmer: That is all.

Mr. Morgan: That is all.

(Witness excused.) [304]

Mr. Wilmer: I would like to call Mr. Zannaras for cross-examination, for a few questions.

JOHN PHILLIP ZANNARAS

called by the defendant as an adverse witness for cross-examination under the statute, having been first duly sworn, testified as follows:

Direct Examination

By Mr. Wilmer:

Q. Your name is John Phillip Zannaras?

A. Yes, sir.

(Testimony of John Phillip Zannaras.)

Q. Are you one of the parties to this case, Mr. Zannaras? A. Yes.

Q. Mr. Zannaras, when was the last time that your mill was operated?

A. Some time in 1952.

Q. In 1952? A. Yes.

Q. And for how long a period?

A. Well, we worked for about six months or eights months, something like that. I don't remember the exact time, six or eight months, about.

Q. When did you begin operating?

A. It may have been in January, something like that. [305]

Q. Of 1952? A. Something like that.

Q. That is the mill, now, on Burro Creek?

A. Yes.

Q. What type of ore did you put through it?

A. Tungsten.

Q. What was done with the concentrates?

A. We sold them. That is all in evidence here.

Q. I am sorry. I am getting behind myself. That occurred prior to the other trial of this matter?

A. Yes.

Q. I am sorry. I didn't mean it that way. I meant since the last hearing of this has the mill been operating?

A. When was the last hearing?

Mr. Morgan: Two years ago. 1952.

Mr. Wilmer: May of 1952.

The Witness: We were operating after that.

Q. (By Mr. Wilmer): Pardon?

(Testimony of John Phillip Zannaras.)

A. We were operating after May, 1952, I think after September.

Q. Do you recall that you were or were not?

A. I am not quite sure about the dates. [306]

Q. You had records of the place to which the concentrates were shipped?

A. We ordered this put in evidence here, whatever they are.

Q. I am speaking of any operation after that time.

A. No, we have no operation after that

Q. After the trial? A. No.

Q. You have none. Have you begun the construction of a new mill? A. Yes, sir.

Q. And where is that located?

A. Well, the new mill is part of—I don't call it a new mill. It is an addition to the other mill.

Q. I understand. Where is that located?

A. It is located at the mine.

Q. And the mine is approximately how far from the creek? A. About ten miles.

Q. Your mine is approximately ten miles from the Burro Creek? A. Yes, sir.

Q. And this new mill that you are constructing there is approximately ten miles from Burro Creek? [307] A. That is right.

Q. What is your source of water for that mill?

A. We going to grind it and dry it and transport it to Burro Creek for separation down there.

Q. You are going to grind it there at the mine?

(Testimony of John Phillip Zannaras.)

A. At the mine, and transport it and concentrate it at Burro Creek.

Q. The mill is actually several miles from the mine? A. No, not several miles.

Q. The mill which you are presently constructing? A. Yes.

Q. Is approximately two miles from your mine, is it not?

A. It is right in the mine. It is right in the mine, next to the mine. The new mill is next to the mine.

Q. Within what distance, in feet?

A. About fifty feet.

Q. Is that the only new construction which you have in that area? A. Oh, no.

Q. You have some additional construction that is a couple miles away from the present mine headquarters? [308]

A. No. Well—what do you mean, construction? New construction, you mean?

Q. Well, now, referring, Mr. Zannaras, to the shaft of your mine that we have referred to before?

A. Yes.

Q. I believe it is around that that you have constructed some of your dwellings, these buildings?

A. Yes, a camp.

Q. At the shaft?

A. A camp, a mining camp.

Q. A camp, that is right? A. Yes.

Q. Now, from the shaft to the mine to this new mill is how far? A. A mile and a half.

Q. A mile and a half? A. Yes.

(Testimony of John Phillip Zannaras.)

Q. You are going to load the ore at the shaft and transport it to the mill?

A. I got ore next to the mill. We got ore next to the mill.

Q. What?

A. We got ore next to the mill. The big deposit is next to the mill.

Q. What I am getting at is, you propose to [309] load your ore at the shaft at the mine?

A. No.

Q. You are abandoning that, are you?

A. No, we are not abandoning it. We got that property—that property is almost two miles long, and that property extends all the way up to the shaft, and we have different workings, different parts of the property. The main object for that, we are going to mine by open pit next to the mill, which is about a few feet away.

Q. In other words, you are opening a new——

A. No, we don't open a new——

Q. Pardon me. You are leaving the existing workings in shaft—— A. No, we don't.

Q. Pardon me. You are starting your open pit operation about a mile and a half from the old shaft, is that correct? The open pit you are talking about that is next to the mill is a mile and a half from the camp and the shaft?

A. There are many workings in between the mile and a half.

Q. You propose to mine that open mill and grind it dry? A. Yes, grind it dry.

(Testimony of John Phillip Zannaras.)

Q. And then load it and haul it to the mill [310] and mill it there? A. Yes.

Q. And then haul it back, haul it in to the mill-site?

A. No, the concentrates we will haul back.

Q. You have had no operation of the mill at all since the last trial? A. No.

Q. There has been ample water at all times, has there?

A. No. Well, there has been water there, yes.

Mr. Wilmer: That is all.

Mr. Morgan: Just a minute, Mr. Zannaras.

Q. (By Mr. Morgan): What have you done, if anything, at the mill down at the river?

A. We put in new—we are doubling the capacity. We are just putting new tables on with the foundations, and we put new elevators. And we want to double the capacity down on Burro Creek, and we are going to put in flotation also.

The Court: We will suspend until ten in the morning.

(Thereupon at 4:30 p.m. an adjournment was taken to the following morning, March 11, 1954, at 10 o'clock a.m.) [311]

Thursday, March 11, 1954—10 A.M.

Mr. Wilmer: Mr. Zannaras, will you take the stand again?

JOHN PHILLIP ZANNARAS

resumed the stand and testified further as follows:

Direct Examination
(Continued)

By Mr. Wilmer:

Q. Mr. Zannaras, subsequent to the last hearing, you learned of the fact that Bagdad had filed an application for a permit to construct a dam above their point of diversion to store flood waters, did you not? [312]

A. Will you repeat the question?

Q. Subsequent to the last hearing, you learned that Bagdad Corporation filed with the State Water Commissioner an application for a permit to construct a dam in the rocky canyon above Bagdad sump to restore flood waters, did you not?

A. I did know about it, but at the time I learned it—I don't know whether it was correctly stated in your statement as to the time I learned it.

Q. You have learned about it?

A. I have, but I don't know whether it was that time.

Q. Immediately subsequent to that, you filed with the Land Management Division of the Department of the Interior an application for a reservoir site?

A. No.

Q. Pardon me. Did you file an application for a reservoir site subsequent to that?

A. I did file. Whether subsequent or prior, I do not know.

(Testimony of John Phillip Zannaras.)

Q. Where did you get the survey that you used to describe the reservoir which you proposed to construct? A. I went up there myself.

Q. Did you survey it yourself? [313]

A. Yes, I went up there myself.

Q. How did it happen that your survey followed exactly the survey of Bagdad?

A. Because it was the only place. I didn't know Bagdad surveyed that.

Q. Mr. Zannaras, you have a water right of 3 million gallons per year? A. That is right.

Q. Why did you file an application for a reservoir site some 12 miles above your point of diversion, for 3 million gallons diversion use?

A. Well, this is——

Q. Why did you file it?

A. Because we have bigger plants to be constructed there, a big mine.

Q. You have a 3 million gallon a year water right; did you propose to store your 3 million gallons above your point of diversion?

A. What was my subsequent plans have nothing to do with it. It was for a right of way.

Q. As a matter of fact, Mr. Zannaras, without arguing about it—— A. Yes.

Q. You did file an application for a reservoir permit? A. No, I did not. [314]

Q. Pardon me. Will you please let me finish the question. You did file an application for a reservoir permit which followed almost to a "T" the application of Bagdad Copper Corporation, did you not?

(Testimony of John Phillip Zannaras.)

A. No, I did not. I filed application for a right of way.

Q. Well, it is known as a reservoir permit, is it not? A right of way for a reservoir?

A. No, it is not a reservoir permit. It is a right of way.

Q. It is a right of way to construct a reservoir?

A. Yes.

Q. And it followed exactly the application of Bagdad? A. No, it did not.

Q. Where did it depart from it?

A. What?

Q. Where did it depart from it? Where did it change? A. Everywhere.

Q. Pardon?

A. In every place. It was not the same thing at all.

Q. Well, in any event, Mr. Zannaras you [315] realized that Bagdad desired to store the flood waters so that there wouldn't be any conflict with your use below, did you not? A. No.

Q. How much more time would be required to complete your mill at the mine site where you have the mine?

A. Well, it is practically completed.

Q. And what have you got installed at the present time? A. At the mine?

Q. At the mine.

A. Well, we have an ore bin. We have a crusher. We have a belt conveyor. We have five elevators. We have four vibrating screens.

(Testimony of John Phillip Zannaras.)

Q. Are those all installed and ready to operate?

A. All installed and ready.

Q. All right.

A. We have three large crushing rolls.

Q. How much time will it take to complete the installation?

A. It is completed practically.

Q. Ready to operate?

A. It won't take very long. Power is what we need. [316]

Q. What is your source of power going to be?

A. A Diesel engine.

Q. A Diesel engine. Do you have the engine?

A. Not yet.

Q. What is the capacity of that mill?

A. About 250 tons, from 250 to 500 tons a day.

Q. I understood you to say that you intended to double the capacity of the mill also at the Burro Creek location? A. Yes.

Q. That will be only for the treating of the powdered rock after it has been ground?

A. Yes.

Q. Now, do you intend to operate your mill at the mine at capacity?

A. Yes, I mean to operate at capacity if we can.

Q. You intend to mill 250 tons a day?

A. That is right.

Q. And run that through the mill down at the creek then? A. Yes.

Q. To concentrate it? A. Yes.

(Testimony of John Phillip Zannaras.)

Q. Where are you going to get the water [317] for that, Mr. Zannaras?

A. There is plenty of water in Burro Creek.

Q. There is plenty of water in Burro Creek?

A. We want to get a different right besides that for the water in Burro Creek.

Q. Where are you going to get the water in the summertime?

A. We got water all right for summertime.

Q. 250 tons a day would take approximately 750 tons of water, would it not?

A. No, it would not.

Q. How much would it take? A. 250 tons?

Q. Yes.

A. I can get that with about 60 tons.

Q. 60 tons of water? A. That is right.

Q. Do you know of any mining operation that can mill——

A. Yes, I do. I can show it to you.

Q. All right, let me see it.

A. On page 20-13 of Handbook for Mineral Dressing, by Taggart, it is shown that at the Eagle Picher, Ruby, it is a flotation method and runs 400 tons of ore per 24 hours, and a total recovery of water, 95 per cent. That is on 400 tons of ore [318] in twenty-four hours, only 40 tons of water.

Q. May I see that, please?

A. Yes. (Handing to counsel.)

Q. This figure that you have given us, Mr. Zannaras, is I think 95 per cent recovery of the water, is it not? A. That is right.

(Testimony of John Phillip Zannaras.)

Q. So that you would have to install filters. Actually, you are using 40 tons, but recovering and reusing the water?

A. We have a thickener there. We do have the facilities. I have tanks there.

Q. Do you intend to recover and re-use the water at the mill? A. Yes.

Q. At the millsite at Burro Creek?

A. Yes.

Q. Is that all set up to go?

A. Practically, yes.

Q. To handle 250 tons?

A. Well, right now, no, but we are practically ready.

Q. Where are these installations that you speak of at the millsite?

A. On Burro Creek, it is a thickener.

Q. A thickener to handle 250 tons? [319]

A. Yes.

Q. Then I take it that you propose to re-use the water, is that right? A. Yes.

Q. You are going to get by on 3 million gallons per year, handling 250 tons of ore a day?

A. Yes, I can do that.

Q. Why was the mill constructed where it is, Mr. Zannaras? At the mine, instead of down at the creek?

A. Because that is where the water is.

Q. Why wasn't the mill constructed down at the creek where the water is? A. The new place?

Q. Yes. A. Do I have to tell you that?

(Testimony of John Phillip Zannaras.)

Q. I would like to know.

A. It may be some secret of mine. I may have some secrets there that I may not have to tell you.

Q. Why? I would like to have the reason.

A. Because I can use it for other minerals there that don't require water, and then you can mill them up there.

Q. You propose to haul the powdered ore——

A. Yes.

Q. ——to the mill at Burro Creek? [320]

A. That is right.

Q. That road down to Burro Creek is a sandy wash, is it not?

A. No, it is a very good road.

Q. Mr. Zannaras, that road is one you even have trouble getting through with a truck at times, do you not? A. No, I don't.

Q. I did.

A. Well, you are probably a bad driver.

Mr. Wilmer: That is all.

Mr. Morgan: Just a few questions, Mr. Zannaras.

Cross-Examination

By Mr. Morgan:

Q. How much money—since the trial of that action—— A. Yes.

Q. In, I think it was May, 1952, how much money have you actually spent up at the mine?

A. That was about $100,000.

Q. That included the building of this crushing mill? A. Yes, sir.

(Testimony of John Phillip Zannaras.)

Q. And the installation of the other equipment?

A. That is right. [321]

Q. Did you do any other work in the way of development?

A. Yes, we developed the shaft to 200 feet.

Q. Did that add to your ore resources?

A. Yes, it did.

Q. I believe you testified fully as to the ore that was developed? A. Yes, sir.

Q. At the prior trial? A. Yes, sir.

Q. Has there been any change in the values of that ore?

A. Well, it is a better ore at the shaft. We get a richer ore at the shaft.

Q. I don't know whether you testified to the value of the pit ore? A. I already testified to it.

Q. You did? A. Yes, I did.

Q. Do you remember the amount?

A. Yes. It runs about 18 to 20 dollars a ton.

Q. What about the ore in the shaft?

A. The ore in the shaft runs from $60 down to $40.

Q. What is the extent of the bodies that have been developed in the shaft? [322]

A. As far as I know, we find ore all the way down to the bottom of the shaft.

Q. In what widths?

A. Almost the entire width of the shaft.

Q. How wide is the shaft?

A. Oh, it is about six feet, the ore part.

(Testimony of John Phillip Zannaras.)

Q. Now, then, what money have you spent on the mill at the creek?

A. At the creek we spent about $10,000.

Q. What will be the capacity of the mill at the creek when you finish your present installations, the ones you expect to put on presently?

A. We are going to start with 160 tons and go up to 250 tons.

Q. Now, you were asked whether or not you did any milling down at the creek after the trial of the action in May, 1952? A. Yes, sir.

Q. Have you looked up your records on that since?

A. Yes, I checked up, and we milled up to June, 1952. A. Why did you quit?

A. Well, the water started being low again.

Q. Then after June, 1952, up to the present time, you have been developing the mine? [323]

A. Yes, sir.

Q. And doing some work on this mill to enlarge it? A. That is right.

Q. And you have made changes, I take it, on the mill?

A. Yes, just making for a recovery—we found quite a few points we are going to increase the recovery of the tungsten considerably.

Q. I believe you have already testified as to how the water runs down the creek to your point of diversion? A. Yes, I did.

Q. When it is not being pumped out above?

A. Yes.

(Testimony of John Phillip Zannaras.)

Q. I don't want to go back into that.

A. All right.

Mr. Morgan: I guess that is all. I believe that is all.

Redirect Examination

By Mr. Wilmer:

Q. One question. What happened to the product of your milling until June, 1952?

A. I think we sold it.

Q. Do you know who you sold it to?

A. To Kennametals Company. [324]

Q. How much did you get for it?

A. I don't remember.

Q. Do you have any records of how much money you have actually realized from any milling operations there? A. Yes.

Q. Do you have any records?

A. Yes, we have records.

Q. Where are they?

A. Up at the place, in the mines.

Q. What do they consist of?

A. The returns. They sent us a return.

Q. Do you have an actual book which shows the amount of concentrate sold and the price for it?

A. We may have the returns.

Q. Do you have a record to keep track of what you get from selling concentrates?

A. I may have.

Q. Don't you know?

(Testimony of John Phillip Zannaras.)

A. Because we were reorganizing at the time. We were reorganizing the company.

Q. What did you use for making out income tax returns?

A. We have got records.

Q. You have got records which show just what you are taking in from your operations? [325]

A. It was just testing operations, don't forget that. It is just testing.

Q. You were testing since 1942? That is in substance what you have been doing up there, testing and developing new mines?

A. We were developping the mine, and I built a big mill up there now, and it takes time.

Q. Your mill at Burro Creek has been ready to run since 1942, has it not?

A. Ready to run?

Q. Yes, been ready to operate since 1942?

A. I told you we developed the mine. The mill was ready to receive ores.

Q. Since 1942 the mill at Burro Creek, according to your testimony, has been in a condition to operate, has it not?

A. Yes, it will operate.

Q. Since that time you have continued to revise the mill and open new mining bodies, but have done no mining, substantially?

A. Well, substantially, there is nothing.

Mr. Wilmer: That is all.

Mr. Morgan: That is all.

(Witness excused.)

Mr. Wilmer: I would like to recall Mr. Dickie for a brief question or two, your Honor. [326]

May this be marked for identification.

The Clerk: Defendant's Exhibit AE for identification.

(Said document was marked Defendant's Exhibit AE for identification.)

Mr. Morgan: Could I ask some questions on this?

Mr. Wilmer: This, if the Court please, is the exhibit Dr. Thiele testified as having prepared. It shows the average gauge readings for 1953.

Exhibit X was marked for identification. I see I did not think to offer it. I am offering it in evidence on the basis of the predicate previously laid. The previous gauge readings are in evidence from the previous hearing.

And I am now going to offer for your further information the daily gauge readings for 1953, which will take care of your objection that that is the average.

Mr. Morgan: Well, that is all right.

Mr. Wilmer: We offer Defendant's Exhibit "X" in evidence.

The Court: All right.

The Clerk: Defendant's Exhibit X in evidence.

(Said document was received in evidence and marked Defendant's Exhibit X.) [327]

DEFENDANT'S EXHIBIT X

Bagdad Copper Corporation
Bagdad, Arizona

Average Monthly Flow Gauge Readings
Burro Creek

Month	1949	1950	1951	1952	1953	Average 1949-53
Jan.		.419	.436	1.119	.590	0.641
Feb.		.432	.423	2.238	.507	0.800
Mar.	1.929	.400	.384		.539	0.813
Apr.	.573	.318	.367		.500	0.439
May	.277	.157	.269		.400	0.277
June	.180	.000	.000		.133	0.078
July	.000	.097	.098	.294	.352	0.168
Aug.	.000	.110	1.512	.329	.594	0.509
Sept.	.107	.155		.270	.230	0.191
Oct.	.107	.045		.413	.207	0.193
Nov.	.350	.040		.510	.640	0.385
Dec.	.432	.334		.587	.503	0.464

Admitted and filed March 11, 1954.

ERNEST R. DICKIE

recalled as a witness for the defendant, having been first duly sworn, testified further as follows:

Further Direct Examination

By Mr. Wilmer:

Q. Mr. Dickie, I didn't ask you to identify the monthly and daily gauge readings for 1953, and I am now handing you Defendant's Exhibit AE for identification, and ask you if that is the record of Bagdad, the monthly and daily gauge readings for 1953? A. Yes, sir.

Mr. Wilmer: I offer Exhibit AE in evidence.

(Testimony of Ernest R. Dickie.)

Mr. Morgan: I guess the gauge readings have already been testified to.

Mr. Wilmer: 1953 wasn't.

Mr. Morgan: All right.

The Clerk: Defendant's Exhibit AE in evidence.

(Said document was received in evidence and marked Defendant's Exhibit AE.)

Q. (By Mr. Wilmer): Now, Mr. Dickie, the water supply referred to, the water supply handbook referred to by Mr. Zannaras, specifically referring to the Eagle Picher, Ruby, are you familiar with operations such as are indicated that were carried on at that point? [328]

A. Yes, sir.

Q. Do you know of any such operation which is in use in the country today?

A. Actually, I don't know of an operation running today using, or employing that process.

Q. Do you know of some that did employ it in the past?

A. Yes, sir, I visited this mine at Ruby when it was in operation.

Q. Is it in operation now?

A. No, sir. And there was another one at the foot of Yarnell Hill that used the same method of recovering water.

Q. Why has that use been abandoned?

A. Costwise, mainly. It costs a good deal more to mill a ton of ore and employ the use of thickeners and filters, and the disposal of the tailings and

(Testimony of Ernest R. Dickie.)

in most operations where they have kept accurate cost records, it shows that the cost is more than in the methods used today.

Q. Now, I notice this refers to tons of water in circuit per ton of ore? A. Yes, sir.

Q. In the operation it requires, then, how many tons of water in circuit per ton of ore being milled? [329]

A. Well, as that table shows there, they have to have two tons of water per ton of ore in the circuit at all times. In other words, if that is a 400 ton plant, that would be 800 tons of water in the circuit. And in the circuit means all through the process, agitators, thickeners, flotation equipment, everything that would have the water in it.

As the ore is passing through the plant, and the minerals have been extracted, as in that case, by flotation, the pulp then is thickened with thickeners, and from there the pulp was filtered over filters. The tailings then were discharged by, well, in one case by means of a dragline that took the tailings, because they are only carrying five to ten per cent moisture at the most, and stacked them up out of the way.

Q. They can't be pumped? They have to be handled by dry methods?

A. No, they can't be pumped.

Q. You have been fairly recently at the Zannaras mill? A. Yes, sir.

Q. Have you been up to the mill?

A. Yes, sir.

(Testimony of Ernest R. Dickie.)

Q. Does that have any—the beginnings, even, of any equipment sufficient to handle water on the [330] same basis that Eagle Picher handled it?

A. No, sir.

Q. What would be required in addition to what is there?

A. He is talking about handling 250 tons a day. The tank that he has installed—this is just my opinion——

Q. I want your observation.

A. The tank he has installed for thickener would nowheres near handle it.

Q. What would it handle?

A. Oh, I would say 25 tons a day would probably be as much as that thickener would handle. Then there are no filters, or anything like that, installed. And there is no equipment there on the site to dispose of the tailings after filtering.

Q. Now, Ernest, subsequent to this last hearing in May of 1952, and I believe previous to that, did the company proceed with engineering studies and plans for the construction of a dam above your sump to catch and impound flood waters?

A. Yes, sir.

Q. What was the proposed capacity of the dam which you were going to build at that time?

A. Approximately 20 thousand acre feet.

Q. I believe you previously testified you [331] have had considerable experience in measuring waters? A. Yes, sir.

(Testimony of Ernest R. Dickie.)

Q. Can you tell me whether or not it is at all unusual to have one flood through the year that would fill that dam completely?

A. It is not unusual.

Q. I believe there was considerable engineering done and an application filed with the State Water Commissioner for a permit to construct the dam?

A. Yes, sir.

Q. Subsequent to that, was a protest filed by Mr. Zannaras objecting to the construction of that dam?

A. Yes, sir.

Q. And did you later ascertain that he had filed an application for a reservoir permit?

A. Yes, sir.

Q. Have you since changed the proposed dam site location? A. Yes, sir.

Q. And where have you moved it?

A. Approximately half a mile below our point of diversion.

Q. Below a mile or so the former dam site application? [332]

A. Yes, probably a mile and a half.

Q. Are you proceeding presently with diamond drilling for the purpose of determining if that is an appropriate dam site?

A. Yes, sir.

Q. And I believe an amended application has been filed for a permit for that dam site, is that correct? A. Correct.

Q. You propose to store flood waters and to

(Testimony of Ernest R. Dickie.)

release the normal flow of the creek through the dam, is that right?

A. That was our intention.

Q. In addition, what other things has Bagdad done for the purpose of ascertaining if a supplemental fresh water supply can be obtained?

A. We have done considerable work the last ten years in trying to locate some source of water by drilling. However, most of the drilling in the past has been done right around close to the mine, but without success. We have got maybe in one hole, we did get a very little water, but not nowheres near enough to amount to anything.

At the present time we are making a complete study of the area with the idea in mind of trying to find a location whereby we can drill and [333] secure water in the amount of not less than 400 gallons a minute.

Q. Is that one of the purposes of the employment of Dr. Thiele, to examine the course of the old channel up above, and see if that does not carry some water supply? A. Correct.

Q. I believe now at Bagdad you have a substantial little town there, is that correct?

A. Yes, sir.

Q. Approximately how many people in it?

A. Between 16 and 18 hundred population now.

Q. Can you tell us the amount of fresh water which you have to have for the purpose of supplying the requirements of those people for domestic uses?

(Testimony of Ernest R. Dickie.)

A. Right at 200 gallons a minute at the present time.

Q. You hope to find a well, perhaps, that would give you that supply, in the event Mr. Zannaras' position is finally sustained, is that correct?

A. Yes, sir. And I would like to interject another thought along that line.

The waters of Burro Creek are not satisfactory to the Health Department of the State of Arizona for domestic use without being treated. [334] Therefore, we do have a treatment plant there, but there are times during the year when freshets come down the creek that the water is very muddy, and consequently there is not, or it is not very good for domestic water, and the thought being that if we could secure water from a well, that we would eliminate the possibility of contamination of mud, and so forth, during the flood season.

Q. That work is going forward presently?

A. Yes, sir.

Mr. Wilmer: I think that is all.

Cross-Examination

By Mr. Morgan:

Q. This is not strictly cross-examination on this, but could you tell me the altitude at your point of diversion? A. The altitude?

Q. Yes, and how much would fall——

A. Approximately 24 hundred, if I can recollect right.

(Testimony of Ernest R. Dickie.)

Q. And what is the altitude at Kingman Crossing, if you know?

A. I don't believe I really know.

Q. Maybe that is in these plats?

A. Three or four hundred feet lower, I think. (Indicating on chart.) About 21 hundred. [335]

Q. 21 hundred feet down to the Zannaras?

A. Yes. Yes, elevation at Zannaras at about 21 hundred, and the Kingman Crossing would be somewhat higher. At the Kingman Crossing about 2,250.

Mr. Morgan: That is all. Thank you.

Mr. Wilmer: That is all.

(Witness excused.)

Mr. Wilmer: That is all we have, your Honor.

Mr. Morgan: I would like to cross-examine Mr. Fletcher a little more.

The Court: All right.

HERBERT C. FLETCHER

recalled as a witness, having been previously duly sworn, testified further as follows:

Further Cross-Examination

By Mr. Morgan:

Q. Mr. Fletcher, I asked you some questions about the evaporation of not ground water, but of surface water, the running stream. You are, of course, an expert, and familiar with what the evaporation would be of a running stream, I presume, running a certain distance?

(Testimony of Herbert C. Fletcher.)

A. You mean the total length of that area?

Q. Well, this is the question.

Assume that, say, 225 gallons of water [336] was allowed to escape continually down this creek from the Bagdad sump; and assume further, now, for this question, that there was no seepage—don't take into consideration the seepage; and also taking into consideration the fact that the fall in that distance, which is about four miles, is 150 feet; could you give us an idea in gallons, or as near as you could, what percentage of the water during the dry seasons would be taken from that stream by evaporation alone, for that gallonage?

A. No, I couldn't give you any figures like that, because I don't know what the evaporation rate is on that channel.

Q. I think the evidence heretofore is that the evaporation rate amounts to about 75 inches a year?

A. Well, that is up at Bagdad that is on the evaporation pan.

Q. Assume that the evaporation rate, for instance, in a certain month—the only months we are interested in are the summer months—would run at the rate of, say, nine or ten inches for the month.

What I am trying to find out is, are those conditions, assuming that that amount of water was allowed to escape, how much of this water would you [337] expect to reach the Kingman Crossing, eliminating seepage, now?

A. Well, that is another point, too. There is

(Testimony of Herbert C. Fletcher.)

another point, too, there. You see, I have no idea as to what the temperatures are down there at the bottom, which, with running water, actually there is much more evaporation from running water where it is shallow like that than there is from an open surface pan.

Q. You testified generally that you took into consideration in making your charts the temperature?

A. When I take into consideration the temperature, I take it over a broad area.

Q. There wouldn't be much difference, would there? A. There certainly would.

Q. Just assume for this answer that the evaporation would amount to, say, in the dry months, ten inches per month. Now, what I want you to say, if you are able to say it, of course, is what percentage of the water under those conditions would actually reach the Kingman Crossing?

A. I don't think I would be in a position to say exactly until we made some measurements.

Q. Could you give an opinion on it? [338]

Mr. Wilmer: How wide an area is it flowing over?

The Witness: I don't know the area the stream channel covers. I don't know the amount of rock sticking out of the channel. There are a lot of factors that would cause that thing to vary, oh, one hundred per cent on a figure I might give.

Q. (By Mr. Morgan): Well, you testified that in your opinion if all the water were allowed to flow

(Testimony of Herbert C. Fletcher.)

down there, that none of it would reach the Kingman Crossing?

A. That is right, according to this chart right here.

Q. According to your charts?

A. That is right, based on this one here, of flow.

Q. Now, I am asking you to assume a situation whereby——

A. You are trying to tie me down to surface water.

Q. That is right.

A. That is a thing that I just don't feel you can tie it down to, because you have got to take into consideration you are getting a recharge from the underground water, too.

Q. Make this assumption, and maybe you [339] can answer this.

Allow 225 gallons to escape at the sump, the Bagdad sump, and assume that that runs down a channel that is impervious to seepage; and the channel has an average width, that is, the water at the surface would be five feet across, and the mileage is four miles, and the fall is 150 feet down to the Kingman Crossing, what percentage of the water would in all probability reach the Kingman Crossing?

A. If you put that down in a line canal—I think the Salt River Valley people here figure that they lose about 30 and 40 per cent per mile on the line canals from temperatures.

Q. 30 or 40 per cent a mile? A. Yes.

(Testimony of Herbert C. Fletcher.)

Q. Then in three miles they would lose all their water?

A. If you want to assume that condition.

Q. How would the water ever be carried, as it is carried, for distances to 10, 20, and 50 miles?

A. They have to put in enough up at the top to supply that amount.

Q. The rate of evaporation would be constant, wouldn't it, whether it was a small amount or [340] large amount, practically constant?

A. Practically; what do you mean by practically?

Q. Just what I said.

A. The thing is you would have to put in more water up here. You would have to put in enough water up here to take care of the evaporation. They put in more water up here at the head, enough to take care of the water, to push it down through, to take care of the water at the bottom.

Q. The more water you put in, the more evaporation there would be, isn't that right? A. No.

Q. Can't you answer that question?

A. Of course there isn't.

Q. Let me ask you this question: You are an expert on these things?

A. As I told you, I object to your word "expert," but go ahead.

Q. How long would it take water starting at point B to reach this Kingman Crossing, a distance of four miles—— A. I have no idea.

Q. Taking into consideration the fall of 150 feet? A. I have no idea. [341]

(Testimony of Herbert C. Fletcher.)

Q. You claim to be an expert, you ought to know that.

A. I don't claim to know how long it takes water to go down that channel.

Q. You have no idea?

A. No; I have no idea how long it takes. There are too many factors involved.

Q. Let us assume——

A. What is the purpose of assuming anything like that?

Q. I am just trying to find out the answer in this case, of whether or not water can be allowed to come down here without a tremendous loss?

A. I think, as I have already testified, that it can't.

Q. That it can be allowed to come down without loss?

A. You have got to put in considerably more water up here in order to get it through than you would ever get out down here.

Q. We understand, of course, that there is going to be some loss.

A. This chart right here shows you that the evaporation-transpiration losses far exceed the amount you are putting through.

Q. Of course, that is based entirely on [342] your charge at Bagdad, and didn't take into consideration the water that came down from above?

A. This is taking the stream flow record, right here.

(Testimony of Herbert C. Fletcher.)

Q. Will you answer this question, or not? What do you want to do? I can't force you to answer it.

A. Well, I can't say. There are too many factors that would influence that. Certainly, you would have to put in considerably more water up at the head than you would ever expect to get out.

Q. Assume you run 225 gallons of water through a ditch straight for a distance of four miles?

A. You would have very little left.

Q. In one day.

A. You would have very little of it left at the end.

Q. What would the percentage of evaporation be?

A. Well——

Mr. Wilmer: We object to that unless he specifies the depth of the ditches, the width of the ditch, and the exposure of the water to air.

The Witness: A ditch? It is just an impossibility to answer a question as vague as that.

Mr. Morgan: Let us go back again to this [343] ditch proposition.

Q. Suppose you have a ditch four miles long, and the fall in that distance is 150 feet. How long will it take water to reach the four-mile point?

A. Well, that would have to be calculated. I don't have the tables to calculate it.

Q. You don't know how to calculate it?

A. I do by tables.

Q. You do have tables available, don't you?

A. No; I don't.

(Testimony of Herbert C. Fletcher.)

Q. And without tables, you can't calculate it? You can't give us any idea?

A. Dr. Thiele, he is the one you are questioning on the movement of water. I am——

Q. You qualified as an expert here and put in various and sundry records showing your ability as an expert in connection with water.

A. I have experience. I say I can do it if I have the tables to do it, but you have to know the various coefficients of friction, and the type of material that the ditch lining is lined with, whether lined with concrete, asphalt, whether it is an open earth ditch. Those are all factors that have to be brought in to a figuring of the speed of the water running through this ditch.

Q. Assume that it is an open earth ditch. [344]

A. I can't assume——

The Court: I have other things to do. We are not getting any place here.

The Witness: There are just too many factors that can't be answered.

Q. (By Mr. Morgan): Suppose it were run down in a pipe that distance, could you tell us?

A. No, because I don't know the coefficients of friction—whether you are running it down in a steel pipe, whether you are running it down in a concrete pipe. I don't know the coefficient of friction, the frictional loss. If you are running it down in a steel pipe, of course, you are doing away with evaporation.

Q. There would be no evaporation loss?

(Testimony of Herbert C. Fletcher.)

A. Essentially no evaporation loss.

Mr. Morgan: That is all.

Mr. Wilmer: That is all.

(Witness excused.)

Mr. Wilmer: That is all we have, your Honor.

The Court: Do you have anything?

Mr. Morgan: Yes; I have. I will recall Dr. Thiele. I would like to clear up this situation. This is for cross-examination. [345]

HEINRICH J. THIELE

resumed the stand and testified further as follows:

Further Cross-Examination

By Mr. Morgan:

Q. Just a question or two, Doctor.

Assume for the purpose of this answer that you have 225 gallons of water flowing down a ditch that doesn't lose any water by percolation, and that the ditch is five feet wide at the surface? A. Yes.

Q. And it flows four miles, and the descent during that four miles is 150 feet. Would you be able to tell me what the loss for evaporation would be, the percentage of loss?

A. I would have to have the tables of temperatures, and different figures.

Q. Assume that the temperature is the temperature at Bagdad, and assume it is in the summertime, and it is hot.

(Testimony of Heinrich J. Thiele.)

A. Then you have certain conditions that are comparable with the pan evaporation that is mentioned here (indicating on chart); open water surfaces where we have 70 per cent of pan evaporation.

Q. Would you have any idea under those circumstances how long it would take the water to run down?

A. You have to have the number of [346] friction, and the width of the canal, and all these different figures, and you need the tables to look it up.

Q. Do you have the tables available?

A. I don't have the tables available.

Q. And you cannot answer those questions?

A. I cannot answer the question without having the tables and other material available for engineering purposes necessary.

Q. Could you assume that instead of a ditch, 225 gallons would run through a pipe beginning at an elevation of 150 feet to——

A. You would need a pipeline with an awful big diameter in order to move the water through. I need again hydrologic tables which give you exactly the diameter to move water through.

When you take a pipe of small diameter, the friction is so high the water would never reach the point.

Q. Of course, there would be no percolating loss, I mean, no loss from evaporation?

A. Not by evaporation. But I don't know the chemistry of the water. It may be that you have a high corrosion effect of the water.

Mr. Morgan: No further questions.

Mr. Wilmer: No questions.

(Witness excused.) [347]

Mr. Morgan: Mr. Robinson, take the stand, please.

The Court: We will have our morning recess.

(Recess.)

The Court: You may proceed.

JOHN P. ROBINSON, JR.

called as a witness for the plaintiffs, having been first duly sworn, testified as follows:

Direct Examination

By Mr. Morgan:

Q. Will you state your name, please?

A. John P. Robinson, Jr.

Q. You have testified before in this case, of course? A. Yes.

Q. How long have you been in that Burro Creek section? A. Since 1939.

Q. Have you been there every year since that time?

A. Except two years spent in the Army.

Q. What years were those?

A. May, 1945, to June, 1947.

Q. When you returned in June, 1947, did you go back down to Burro Creek? A. Yes. [348]

Q. I believe 1947 was one of the driest years that we had?

(Testimony of John P. Robinson, Jr.)

A. Well, I was told that up until the time I came here. It was dry when I came here. Previous to that I had understood it had been awfully dry.

Q. After you came back in June, 1947, did you have occasion to observe Burro Creek?

A. I did.

Q. At what points?

A. Practically all along it, except for a short distance through the canyon above our sump.

Q. By that you mean what we term the Zannaras point of diversion, up to the point of diversion which is known as the Bagdad point of diversion?

A. Yes.

Q. Wasn't water running in that stream at that time in 1947?

A. Yes; there was water running.

Q. Did it go down as far as your point of diversion? A. Yes.

Q. What was the width of the stream, I mean, the average width of the stream itself as it ran from the Bagdad point of diversion down to the Kingman Crossing, the average width?

A. Oh, I figure that the average width [349] would be about five feet.

Q. What was the average width at that time, or, practically, the width down at your place?

A. It was around, oh, I think it was about four feet running right there.

Q. Now, have you seen this creek every year since 1939?

A. Except two years that I was away.

(Testimony of John P. Robinson, Jr.)

Q. Excepting the two years you were away?

A. Yes.

Q. And during that period, can you tell the court very briefly, now, referring only to the dry seasons up to the time you went away, how much water was running in this creek, the width of the water above the Kingman Crossing, and the width of the water as it ran down past your point of diversion?

A. Well, the driest that I can remember Burro Creek was back in the latter part of 1939. At our diversion point, the water was around two feet in width.

From the Kingman Crossing where it was very wide, and, oh, up above a mile that I walked, I would say it tapered off to an average of about, oh, three feet or four feet, somewhere in there.

Q. Now, I believe that the evidence in this case shows that the Bagdad people put in their [350] sump and began active pumping operations from their present sump in the year 1948?

A. I think it was 1948, yes.

Q. You have been familiar with the creek since that time? A. Yes.

Q. During the dry season? By that I mean the season from, we will say, May, or the early part of June, until—when does the dry season end there?

A. Well, that depends. That varies. Sometimes it may end in September, and sometimes it may not end until December.

One year I can remember it was December 8th that the dry season ended.

(Testimony of John P. Robinson, Jr.)

Q. Well, since that time has the creek failed to run?

A. Oh, yes; it has failed to run through the summer months since 1948.

Q. And that has been invariable since 1948?

A. Yes.

Q. Just a question or two about your activity since the last trial. What have you done in the way of improvements at the mine?

Mr. Wilmer: I object to that as being immaterial, if the Court please.

Mr. Morgan: You brought it out. [351]

Mr. Wilmer: Okay, go ahead.

The Court: Mr. Zannaras testified to it. Is there any reason to disbelieve him? It would only corroborate what he said.

Mr. Morgan: Yes; I think that is right, Judge.

Q. (By Mr. Morgan): You have done some work on the mill at the river? A. Yes.

Q. Or the creek. You, I believe, were in charge of that work? A. Yes.

Q. What was the purpose of that work done at the mill?

A. To expand the capacity and make better recovery.

Q. To what capacity are you expanding at the present time?

A. At the present time, 150 tons in 24 hours.

Q. How close to completion are you now on that mill?

A. I have got the elevators ready to haul down

(Testimony of John P. Robinson, Jr.)

and set up. I have got the two tables to set on the foundations, and the sizer to put in.

Q. Now, after the trial of this action that was held in May, 1952, did you do any milling? [352]

A. Yes; we milled on through, I can't remember the exact dates, because I don't have my payroll book with me.

We milled until some time in June; I think it was toward the latter part of June, and the water started getting low, and the two men that were operating the mill weren't quite satisfied with recovery, so we closed it down, and I moved the men back to the mine some time, as I recall, around the first part of July.

Q. Was there any reason why you haven't done any milling since that time at the river?

A. Well, we weren't prepared at the time to go ahead with any program down at the mill for recovery, due to the former case that was held here, until a decision had been reached.

Q. I see. That is, a decision in the case that is now on appeal, I believe? A. Yes.

Q. The 321? A. Yes.

Q. And it is since that time that you began doing work on the mill to increase its capacity?

A. Yes. In the neighborhood of between eight and ten thousand dollars.

Mr. Morgan: I think that is all. [353]

(Testimony of John P. Robinson, Jr.)

Cross-Examination

By Mr. Wilmer:

Q. Mr. Robinson, did I understand you to say that you were at the creek consistently once a week or better, except for the two years you were in the service?

A. Well, maybe not once a week. Sometimes it might have been fifteen days.

Q. How long were you in California?

A. Oh, four or five months, I think.

Q. How long were you in Phoenix when your wife was having a baby?

A. I think I was here seven days.

Q. You did leave, then, and go to California and work for how many months, do you recall?

A. I believe it was four, four and one-half months.

Q. The reason you didn't go ahead with any milling or changing of your mill at the Burro Creek was because you wanted to await the outcome of the case with respect to your water right?

A. In what year are you referring to?

Q. I am referring to subsequent to 1952, when you shut it down?

A. Well, in referring to the time you are trying to bring out, that I went to California—— [354]

Q. No; I am not referring to that. I understood you to say, in answer to Mr. Morgan's question, that you did nothing with respect to the mill, because you wanted to see the outcome of the case on appeal?

(Testimony of John P. Robinson, Jr.)

A. Mr. Morgan was referring to after 1952.

Q. That is what I was referring to. That is the reason you did nothing, because you wanted to find out if you had a water right, or not?

A. We wanted to wait.

Q. So you would know the outcome of that case on appeal?

A. Yes. Before we went ahead with the construction.

Q. But you are going ahead with the construction anyway? A. Yes.

Q. What is the difference between the outcome of this case here and the case on the appeal?

A. Mr. Wilmer, I believe that is personal convictions, as to the outcome.

Q. You still don't know whether you have a water right or not?

A. That is up to the court.

Mr. Morgan: We object to that. That is something that is up to the court. [355]

Mr. Wilmer: I didn't mean it in that sense. That is all.

Mr. Morgan: That is all.

(Witness excused.)

Mr. Morgan: I would like to call Mr. Dickie for one question.

ERNEST R. DICKIE

called as a witness by the plaintiffs, having been previously duly sworn, testified as follows:

Direct Examination

By Mr. Morgan:

Q. Mr. Dickie, you are a practical mining man?

A. I consider myself to be.

Q. And I presume you know something about piping water? A. I do.

Q. And saving water? A. Yes.

Q. Now, then, in your judgment, what would be —in order to put down water to the Zannaras point of diversion during the dry months, what would be the best method to save water, to get it down there and save it, without loss?

A. At Mr. Zannaras' point of diversion? [356]

Q. Yes.

A. You are asking me a question about the way I think is the proper way——

Q. Yes.

A. The proper way to answer that would be to go down into the gravels at the point of diversion, within that area, and get the water out of the creek.

Q. Yes. I understand that. But assume that you had to deliver the water to the Zannaras point of diversion. A. From where?

Q. From your point of diversion——

Mr. Wilmer: If it please the court——

Mr. Morgan: Just a minute until I finish.

Q. (By Mr. Morgan): How could it be put down with the least loss?

(Testimony of Ernest R. Dickie.)

A. With the least loss?

Q. Yes.

A. Well, a steel pipeline, I imagine.

Q. By pipeline? A. Pipe, yes, sir.

Mr. Morgan: I think that is all.

Cross-Examination

By Mr. Wilmer:

Q. Mr. Dickie, in your experience with [357] underground streams, is there any doubt in your mind but what there is in the underground gravels at the Zannaras point of diversion more than an appropriate amount if he takes it over the whole year, throughout the entire year?

A. I have always felt that there would be ample water there in the gravels at Zannaras' point, at Zannaras' mill to furnish him water the year around.

I base this opinion on the fact that I did some work just like that in the past. We had an operation over at Oatman that required water, and during the summer months there was no surface flow. And we went into the gravels there, and secured enough water to continue the operation year after year.

Another similar case is right up here in our district, over on Santa Maria, a man that owns the S-H Ranch—the Mule Shoe Ranch, I mean to say, was having difficulty in getting enough irrigation water during dry periods, and he come over and asked us what we thought about it. And I told him I thought if he would dig a trench across the creek

(Testimony of Ernest R. Dickie.)

and put in perforated pipe, cover the pipe with coarse material, that he would secure ample water.

Evidently, that has proved to be very [358] satisfactory there. I can't see that Santa Maria creek is much different from Burro Creek.

Q. At the time you are speaking of that this was done, was the Santa Maria showing any surface flow at all? A. No, sir.

Q. Normally, the Santa Maria does not show any surface flow? A. No, sir.

Q. Do you know whether or not this installation was made? A. Yes, sir.

Q. And what was the result?

A. Very satisfactory.

Q. Do you know how much water was obtained? Was it sufficient for irrigation purposes?

A. Yes, sir.

Mr. Wilmer: That is all.

Mr. Morgan: Just one question.

Redirect Examination

By Mr. Morgan:

Q. I take it in view of your testimony you don't agree with the testimony of your expert, Dr. Thiele, when he testified——

A. You say I don't agree?

Q. Yes. [359] A. I certainly do agree.

Q. Wait a minute. When he testified that the underground flow for a year below the Kingman Crossing would amount to 150 acre feet, and during

(Testimony of Ernest R. Dickie.)

the same year the evaporation would amount to 250 acre feet?

Mr. Wilmer: If it please the court——

Mr. Morgan: Let me finish the question.

Q. You heard that testimony? A. I did.

Mr. Wilmer: I object to that, your Honor. There was not any such testimony in the record. He didn't testify to any such thing as that at all.

The Court: I don't know. There was some that I didn't hear or understand.

Mr. Wilmer: In any event, I object to the question, your Honor, upon the ground that it is calling for his conclusion. It is up to the court to determine. Whether he agrees or not is immaterial.

The Court: Yes. The court might not agree with it either.

Q. (By Mr. Morgan): Mr. Dickie, if that is true, that this testimony is correct, there would be no water available at all, underground water, at the Zannaras point [360] of diversion?

Mr. Wilmer: Same objection.

The Court: All right. Same ruling.

Mr. Morgan: You can answer that, can't you?

Mr. Wilmer: No. Same ruling.

Mr. Morgan: I didn't know what the ruling was.

The Court: Sustained.

Mr. Morgan: I beg your pardon. I didn't hear you. Well, that is all.

Mr. Wilmer: That is all.

(Witness excused.)

Mr. Morgan: We rest.

The Court: Do you have anything else?

Mr. Morgan: No.

Mr. Wilmer: That is all.

The Court: All right. I will have to have this written up some time.

Mr. Wilmer: We would like an opportunity, your Honor, to file a memorandum on it.

The Court: Yes.

Mr. Wilmer: Because we have some very definite views with respect to it. Whether or not they are of consequence, I don't know.

The Court: That remains to be seen. All right, how much time do you want after you get a copy of the transcript? [361]

Mr. Wilmer: If it is after the first of the month, I think 20 days.

The Court: All right. Twenty days after you receive the transcript.

(Thereupon, at 11:30 o'clock a.m., March 11, 1954, the case was submitted.) [362]

Certificate

I hereby certify that I am a duly appointed, qualified and acting official court reporter of the United States District Court for the District of Arizona.

I further certify that the foregoing is a true and correct transcript of the proceedings had in the above-entitled cause on the date or dates specified

therein, and that said transcript is a true and correct transcription of my stenographic notes.

Dated at Phoenix, Arizona, this 28th day of April, A.D. 1954.

/s/ JANE HORSWELL,
Official Reporter.

[Endorsed]: Filed May 29, 1957. [363]

PLAINTIFFS' EXHIBIT No. 8

General Services Administration
Region 9—Arizona, California, Nevada
and Territory of Hawaii

Certificate of Authorization
Domestic Tungsten Program

Number 9-1151 Date: June 21, 1951

To: Mr. John P. Zannaras,
Zannarapolis Tungsten Mine,
Box 500,
Congress, Arizona.

Your notice, dated May 21, 1951, indicating your willingness to participate in the Domestic Tungsten Program and your undertaking to prospect for or produce tungsten, has been received. You are hereby authorized to deliver to the Government, in accordance with the terms of the Program, tungsten concentrates meeting the specifications contained therein. Reasonable notice should be given to the

Government with respect to the availability of any tungsten concentrates for inspection.

/s/ ROBERT B. BRADFORD,
Regional Director.

Admitted and filed May 13, 1952.

[Title of District Court and Cause.]

DOCKET ENTRIES

1948

July 12—File Pltf's Complaint.

July 12—File Pltf's Praecipe for Summons.

July 12—Issue summons.

July 30—File Summons returned by Marshal showing service on David H. Palmer, Statutory Agent for Bagdad Copper Corp.

Aug. 20—File Deft's Motion for More Definite Statement.

Sept. 20—Deft's Mo. for More Definite Statement on for hearing Lockwood for Pltf. Jas. Walsh for deft. On agreement of counsel pursuant to said motion order allow pltf. to amend by interlineation to show damages for loss of profits. On mo. Walsh order allow deft. 10 days to answer.

Oct. 1—File Deft's Answer.

Oct. 4—File Pltf's Motion to Set notice for hearing 10/11/48.

1948

Oct. 11—Pltfs' Motion to Set on for hearing. Lorna Lockwood pres. for pltf. No appearance for deft. Order pass one week to permit pltf. to amend complaint to show diversity of citizenship.

Oct. 18—Pltf's Mo. to Set on for hearing. Lorna Lockwood for pltf. Joe Melczer for deft. Counsel for pltf. now files Motion for Leave to Amend Complaint and counsel for the defendant states no objection thereto. Order grant Motion for Leave to Amend and Order set for trial at Phoenix, Thursday, March 3, 1949, 10:00 a.m.

Oct. 18—File Pltfs' Motion for Leave to Amend Complaint.

1949

Mar. 2—File Deft's Praecipe for Subpoena Duces Tecum to C. H. W. Smith.

Mar. 2—Issue subpoena duces tecum.

Mar. 3—On for trial. Z. Simpson Cox, pres. for Pltfs. Mark Wilmer, pres. for Deft. Enter proceedings of Trial. File Pltfs' Exhibits 1 to 7, inclusive. At 5:00 p.m. order recess to 10:00 a.m., March 4, 1949.

Mar. 4—Enter further proceedings of trial. File Deft's Exhibits A, B, C, D, E, H, I, J, K, L and N. (Deft's Exhibits L-1 and M admitted, not filed.) Order allow Deft. to substitute certified copy of Deft's Exhibits L-1 and M, and that originals thereof re-

1949

main in the records of C. H. W. Smith. At 4:55 p.m. order recess to 2:30 p.m., March 7, 1949, for argument.

Mar. 7—Order this case continued for argument until further order.

Apr. 5—File Subpoena Duces Tecum returned by Marshal showing service on C. H. W. Smith.

Oct. 3—On for oral argument or for the fixing of time for the filing of briefs. Simpson Cox for pltf. Wilmer for deft. On stipulation of counsel, order case be submitted on briefs and allow pltf. 20 days to file opening brief; the deft. 20 days to answer and the pltf. 10 days to reply.

Oct. 31—File Plaintiffs' Brief.

Nov. 28—File Defendants' Memorandum.

Dec. 20—File Plaintiffs' Reply to Defendant's Memorandum.

1950

Mar. 27—Pltfs having failed to prove the allegations of their Complaint by a preponderance of the evidence, Order that judgment will be entered for the defendant herein.

Mar. 27—Mail notice to counsel.

May 2—File Plaintiffs' Presentation of Proposed Findings of Fact and Decree.

May 2—File Plaintiffs' Proposed Findings of Fact and Decree.

May 3—File Defendant's Proposed Findings of Fact, Conclusions of Law and Judgment.

1950

May 5—File Plaintiffs' Objections to Findings of Fact, Conclusions of Law and Judgment proposed by Deft.

May 5—File Defendant's Objections to Proposed Findings of Fact and Decree by Plaintiffs.

June 12—File Reporter's Transcript.

Sept. 11—File Pltfs' Motion to Set for Argument as to Form of Decree noticed for hearing Monday, September 18, 1950, at 10:00 a.m.

Sept. 18—Pltfs' Motion to Set for Argument as to Form of Decree on for hearing. Cox for plaintiff. Beauchamp for deft. On motion Cox order continue said Motion to Sept. 25, 1950, 10:00 a.m.

Sept. 25—Pltfs' Motion to Set for Argument as to Form of Decree on for hearing. Cox for plaintiff. Wilmer for deft. Order Proposed Findings of Fact, Conclusions of Law and Decree be set for argument Oct. 2, 1950, at 2:00 p.m.

Oct. 2—This being time fixed for settlement of Findings of Fact and Conclusions of Law. Simpson Cox for pltf. and Mark Wilmer for deft. Findings of Fact and Conclusions of Law are now settled by the Court and counsel for deft. is directed to submit engrossed Findings for signature of Court.

1951

Jan. 2—Enter and file Findings of Fact, Conclusions of Law and Judgment that pltf. take nothing and that deft. recover costs.

1951

Jan. 2—File Stipulation and enter and file Order allowing withdrawal of all proposed findings of fact, conclusions of law, decrees, judgments and objections thereto by attorneys filing same.

Jan. 12—File Deft's Statement of Costs noticed for taxation January 17, 1951, at 10:00 o'clock a.m.

Jan. 17—Tax costs for defendant as claimed in sum of $594.12 and enter same in J.D.

Jan. 17—Mail notice to counsel.

Feb. 8—File Pltfs' Petition for Relief.

Mar. 6—File Deft's Mo. to Make Petition for Relief More Definite and Certain.

Mar. 20—Order grant Deft's Motion to Make Petition for Relief More Definite and Certain.

Mar. 20—Mail notice to counsel.

Mar. 28—File Plaintiff's Amended Petition for Relief.

Apr. 11—Enter payment of $594.12 costs in J.D.

Apr. 16—File Defendant's Answer to Amended Petition for Relief.

June 26—File Pltfs' Motion to Set

July 2—Pltf's Motion to Set on for hearing. J. E. Russell for pltf. and Mark Wilmer for deft. Order Jos. H. Morgan entered as assoc. counsel for the plaintiff. Order set for trial on pending issues Sept. 11, 1951, 10:00 a.m., at Phoenix.

July 16—File Plaintiffs' Praecipe for Witnesses.

1951

July 16—Issue subpoenas.

Sept. 11—File Deposition of John Phillip Zannaras.

Sept. 11—On for trial. Russell for Pltf. Wilmer for deft. Order vacate trial setting and reset for trial Thurs., Nov. 15, 1951, at 10:00 a.m.

Oct. 9—File Subpoenas with Marshal's Return thereon.

Nov. 13—On mo. Jos. H. Morgan, counsel for pltf. Order vacate order setting this case for trial Nov. 15, 1951, and reset for trial Tues., Mar. 11, 1952, at 10:00 a.m., at Phoenix.

No. 14—Mail notice to counsel.

1952

Feb. 21—Joseph H. Morgan pres. for John Phillip Zannaras. Mark Wilmer pres. for Bagdad Copper Corp. On agreement of counsel, Order vacate order setting this case for trial March 11, 1952, and reset for trial Tuesday, May 13, 1952, at 10:00 a.m.

May 13—Plfts' Amended Petition for Relief on for trial. Jos. H. Morgan pres. for pltfs. Mark Wilmer pres. for deft. Order pltf. proceed with proof in this case prior to presentation of evidence in Civ. 321 Prct. Enter proceedings of hearing. File Pltfs' exhibits 1 to 10, incl. File Deft's exhibits A and B (1 to 11). On motion counsel for pltf., Order U. S. Tungsten be added as

1952

a party pltf. herein. At 4:45 p.m., Order recess to 10:00 a.m. tomorrow.

May 13—File Deposition of Ernest Russell Dickie.

May 14—Enter further proceedings of trial. File Pltfs' exhibits 12, 13, 14 and 16. File Deft's exhibits D to L, incl. Order record show this case is submitted without argument and that Bagdad Copper Corporation is allowed 30 days to file opening brief, Zannaras allowed 30 days to answer and Bagdad Copper Corp. 20 days to reply.

Aug. 20—File Reporter's Transcript.

Oct. 24—File Pltf's Opening Brief.

Dec. 17—File Memorandum of Bagdad Copper Corporation.

1953

Jan. 2—File Reply Brief of Robinson and Zannaras.

July 6—Order that the Order of submission herein be vacated for the purpose of taking further evidence.

July 7—Mail notice to counsel.

Nov. 18—File Plaintiffs' Motion to Set for Further Hearing.

Nov. 23—Pltfs' Motion to Set for Further Hearing on for hearing. J. H. Morgan for pltfs. and Mark Wilmer for deft. Order said motion be stricken from the calendar, subject to renewal in the spring.

1953

Dec. 5—File Plaintiffs' Renewal of Motion to Set for Further Hearing, and Affidavit in Support of Foregoing Motion.

Dec. 14—J. H. Morgan for pltf. No appearance for deft. Order set for further hearing, Mar. 3, 1954, at 10:00 a.m. at Phx.

1954

Mar. 2—On for further hearing on Pltf's Petition for Relief. J. H. Morgan for plaintiffs and Mark Wilmer pres. for deft. Order this matter be continued and reset for further hearing Tues., March 9, 1954, at 10.00 a.m.

Mar. 9—On for further hearing on Pltf's Petition for Relief. J. H. Morgan pres. for pltfs. Mark Wilmer pres. for deft. File Deft's Exhibits M, N & O, S, T, U, and V. At 4:40 p.m., Order recess to 10:00 a.m. tomorrow.

Mar. 10—On for further hearing on Pltf's Petition for Relief. File Deft's Exhibits Y and Z, AA, AB, AC, and AD. At 4:20 p.m., Order recess to 10:00 a.m. tomorrow.

Mar. 11—On for further hearing on Pltf's Petition for Relief. File Deft's Exhibits X, AE. Order allow deft. 20 days after reporter's transcript is available to file brief and allow pltf. 20 days thereafter to file answering brief.

June 4—File Plaintiffs' Submitting Memorandum.

1954

June 7—File Plaintiffs' Motion for Submission of Cause, noticed for hearing Monday, June 14, 1954, at 10:00 a.m.

June 14—Plaintiffs' Motion for Submission of Cause on for hearing. Morgan for pltfs. Wilmer for deft. and states deft. has brief ready to file, and will file reply brief within the 10 days allowed. Order record show this matter will be submitted upon filing of reply brief.

June 16—File Defendant's Memorandum.

1956

May 8—File Plaintiffs Motion and enter and file Order substituting Charles Christakis in lieu of Joseph H. Morgan as counsel for pltfs.

Oct. 17—Order that Plaintiffs' Amended Petition for Relief is set for oral argument Monday, Nov. 26, 1956, at 2:00 p.m., at Phoenix.

Nov. 26—Plaintiffs' Amended Petition for Relief for oral argument. Edward B. Ashurst pres. for pltfs. Mark Wilmer appears for deft. Order that Edward B. Ashurst be entered as association counsel for pltfs; argued by Wilmer; by Ashurst. Order record show matter submitted.

1957

Feb. 1—File Plaintiffs' Application for withdrawal of Charles Christakis as one of attorneys of the U. S. Tungsten Corp.

1957

Mar. 29—This cause having been submitted upon Plaintiffs' Amended Petition for Relief, the court finds in its Memorandum filed this date that plaintiffs have failed to prove by a preponderance of the evidence that defendant has appropriated any of plaintiffs' water, and they are not entitled to an injunction. File Court's Memorandum decision.

Mar. 29—Copy of signed memorandum of 3/29/57 mailed to Mr. Wilmer and to Mr. Ashurst.

Apr. 3—File Defendant's Proposed Findings of Fact and Conclusions of Law on Plaintiffs' Amended Petition for Relief.

Apr. 8—File Plaintiffs' Objections to Defendant's Proposed Findings of Fact, Conclusions of Law and Judgment.

Apr. 17—It is ordered that Defendant's Proposed Findings of Fact and Conclusions of Law are approved and adopted as the Findings of Fact and Conclusions of Law on Plaintiffs' Amended Petition for Relief herein.

Apr. 17—Enter and file Findings of Fact and Conclusions of Law, and order that the clerk enter judgment in favor of the defendant Bagdad Copper Corporation and against the plaintiffs John Phillip Zannaras, J. P. Robinson, Jr., and U. S. Tungsten Corporation that said plaintiffs take nothing by their amended petition for relief and that defendant have judgment for costs.

1957

Apr. 17—5:25 p.m., Enter judgment in favor of the defendant Bagdad Copper Corporation, a corporation, and against the plaintiffs John Phillip Zannaras, J. P. Robinson, Jr., and U. S. Tungsten Corporation that said plaintiffs take nothing by their amended petition for relief and that defendant have judgment for costs.

Apr. 17—Mail notice to all counsel of proceedings of 4/17/57 and of entry of judgment.

May 14—File Consent to Substitution of Moeur and Jones as counsel for Plaintiffs in place of Edward B. Ashurst.

May 14—File Notice to Bagdad Copper Corporation and its attorneys of substitution of Moeur and Jones as counsel for pltfs. in place of Edward B. Ashurst.

May 14—File Motion and enter and file Order that Moeur & Jones be substituted for Edward B. Ashurst as attorneys for Plaintiffs.

May 14—File Plaintiffs' Notice of Appeal, showing service of copy on Snell & Wilmer, counsel for defendant.

May 14—File Plaintiffs' Bond for Costs in the sum of $250.00 with Fidelity and Deposit Company of Maryland as surety.

May 29—File Plaintiffs' Designation of Contents of Record on Appeal.

May 29—File Transcript of Record of U. S. Court of Appeals.

1957

May 29—File Reporter's Transcript of Proceedings.

June 17—Enter and file Order Extending Time to file the record on appeal and docket the appeal in the U. S. Court of Appeals for the Ninth Circuit to and including July 23, 1957.

July 20—File Stipulation to include Exhibits Q and R for identification in Designation.

July 20—Prepare and forward Record on Appeal to Clerk, U. S. Court of Appeals, San Francisco, Calif., ($3.20).

[Title of District Court and Cause.]

CLERK'S CERTIFICATE TO RECORD ON APPEAL

United States of America,
District of Arizona—ss.

I, William H. Loveless, Clerk of the United States District Court for the District of Arizona, do hereby certify that I am the custodian of the records, papers and files of the said Court, including the records, papers and files in the case of John Phillip Zannaras, et al., Plaintiffs, versus Bagdad Copper Corporation, a corporation, Defendant, Numbered Civ-221 Prescott, on the docket of said Court.

I further certify that the attached original documents bearing the endorsements of filing thereon

are the original documents filed in said case, and that the attached copy of civil docket entries is a true and correct copy of the original thereof remaining in my office in the City of Phoenix, State and District aforesaid.

I further certify that the said documents, together with the original exhibits transmitted herewith, constitute the record on appeal in said case as designated, and the same are as follows, to wit:

1. Plaintiffs' Complaint, filed July 12, 1948.

2. Defendant's Answer, filed October 1, 1948.

3. Motion of Plaintiffs for Leave to Amend Complaint, filed October 18, 1948.

4. Findings of Fact, Conclusions of Law and Judgment, filed January 2, 1951.

5. Plaintiffs' Petition for Relief, filed February 8, 1951.

6. Defendant's Motion to Make Petition for Relief More Definite and Certain, filed March 6, 1951.

7. Plaintiffs' Amended Petition for Relief, filed March 28, 1951.

8. Defendant's Answer to Amended Petition for Relief, filed April 16, 1951.

9. Plaintiffs' Renewal of Motion to Set Cause for Trial, filed December 5, 1953.

10. Plaintiffs' Submitting Memorandum, filed June 4, 1954.

11. Plaintiffs' Motion for Submission of Cause and Affidavit of Zannaras, filed June 7, 1954.

12. Defendant's Memorandum, filed June 16, 1954.

13. Court's Memorandum on Petition for Relief, filed March 29, 1957.

14. Defendant's Proposed Findings of Fact and Conclusions of Law and Judgment, filed April 3, 1957.

15. Plaintiffs' Objections to Defendant's Proposed Findings of Fact and Conclusions of Law, filed April 8, 1957.

16. Findings of Fact and Conclusions of Law and (order directing entry of) Judgment, filed April 17, 1957 (being the same document as No. 14 above).

17. Reporter's Transcript of Hearing March 3 and 4, 1949, filed June 12, 1950.

18. Reporter's Transcript of Hearing March 9 to 11, 1954, filed May 29, 1957.

19. Plaintiffs' Notice of Appeal, filed May 14, 1957.

20. Bond on Appeal, filed May 14, 1957.

21. Motion and Order substituting attorneys for Plaintiffs, filed May 14, 1957.

22. Civil Docket Entries, including Clerk's notation of entry of Judgment April 17, 1957.

23. Transcript of Record (DC No. Civ-321 Prescott—CA No. 10248), filed May 29, 1957 (which includes Reporter's Transcript of Hearing May 13 and 14, 1952, filed August 20, 1952).

24. Order Extending Time to File Record on Appeal and Docket the Appeal, filed June 17, 1957.

25. Designation of Contents of Record on Appeal, filed May 29, 1957.

26. Stipulation to Include Exhibits Q and R for identification in Designation.

I further certify that the following original exhibits are transmitted herewith as a part of this record on appeal, as designated, to wit:

A. Plaintiffs' Exhibits 1, 2, 3, 4, 5, 6 and 7; and Defendant's Exhibits A, B, C, D, E, H, I, J, K, L, L-1, M and N, admitted in evidence at the trial March 3 and 4, 1949.

B. Zannaras' Exhibits 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14 and 16, and Bagdad's Exhibits A, B, D, E, F, G, H, I, J, K and L, admitted in evidence at the trial of Civ-221-Prescott and Civ-321-Prescott May 13 and 14, 1952 (Exhibit 16 is same document as Exhibit 7 at March, 1949, trial, and Exhibit D is same document as Exhibit K at March, 1949, trial; Exhibits 10 and I are attached to Answer in Civ-321-Prescott, and Exhibit L is pages 126-140 of Reporter's Transcript filed June 12, 1950, being item No. 17 of Clerk's Certificate).

C. Defendant's Exhibits M, N, O, S, T, U, V, X, Y and Z, and AA, AB, AC, AD and AE admitted in evidence at the hearing March 9 and 10, 1954, and Defendant's Exhibits Q and R marked for identification at said hearing.

I further certify that the Clerk's fee for preparing and certifying this record on appeal amounts to the sum of $3.20 and that said sum has been paid by counsel for appellants.

Witness my hand and the seal of said Court this 20th day of July, 1957.

[Seal] /s/ WM. H. LOVELESS,
Clerk.

[Endorsed]: No. 15640. United States Court of Appeals for the Ninth Circuit. John Phillip Zannaras, J. P. Robinson, Jr., and U. S. Tungsten Corporation, Appellants, vs. Bagdad Copper Corporation, a Corporation, Appellee. Transcript of Record. Appeal from the United States District Court for the District of Arizona.

Filed: July 23, 1957.

Docketed: July 23, 1957.

/s/ PAUL P. O'BRIEN,
Clerk of the United States Court of Appeals for the Ninth Circuit.

In the United States Court of Appeals
for the Ninth Circuit

No. 15640

JOHN PHILLIP ZANNARAS, J. P. ROBINSON, JR., and U. S. TUNGSTEN CORPORATION,

Appellants,

vs.

BAGDAD COPPER CORPORATION, a Corporation,

Appellee.

CONCISE STATEMENT OF POINTS TO BE RELIED ON BY APPELLANTS ON APPEAL

Appellants herein, John Phillip Zannaras, J. P. Robinson, Jr., and U. S. Tungsten Corporation, intend to rely upon the following points for reversal of the judgment of the District Court:

1. The District Court erred in ruling that Burro Creek is a seasonal stream, generally wasting away, or tending to waste away during the months of June, July, August, and, on occasion, September, in each year, depending upon the rainfall on its watershed, and that during the remaining months of the year there is generally adequate water in Burro Creek for all claims of both plaintiffs and defendant.

2. The District Court erred in ruling in favor of the upstream junior appropriator-defendant and

against the downstream senior appropriator-plaintiffs based upon the evidence being "insufficient to enable the Court to determine whether the pumping by the defendant Bagdad Copper Corporation during seasons of scarcity has any bearing" on the amount of water reaching the downstream senior appropriator-plaintiffs' point of diversion.

3. The District Court erred in ruling that if the evidence is insufficient to enable the Court to determine as a fact that the use of water by an upstream junior appropriator results in injury to a downstream senior appropriator an injunction will not lie.

4. The District Court erred in ruling that the burden of proof was upon the downstream senior appropriator-plaintiff to prove that the admitted pumping operations of the upstream junior appropriator-defendant resulted in damage to the downstream senior appropriator-plaintiffs.

5. The District Court erred in its ruling denying the application of the downstream senior appropriator-plaintiffs for an injunction restraining the upstream junior appropriator-defendant from interfering with the right of the downstream senior appropriator-plaintiffs to the beneficial use of 3,000,000 gallons of water per annum from Burro Creek, in accordance with the terms of plaintiffs' Certificate of Water Right.

6. The District Court erred in its ruling that the use of water from Burro Creek by the upstream

junior appropriator-defendant did not deprive the downstream senior appropriator-plaintiffs of water at their point of diversion.

7. The District Court erred in its ruling that the admitted use by the upstream junior appropriator-defendant of water from Burro Creek is not proved to be the reason for the lack of water at the downstream senior appropriator-plaintiffs' point of diversion.

8. The District Court erred in its ruling in favor of the defendant and against the plaintiffs in that the matter of deprivation of water by the upstream junior appropriator-defendant to the detriment of the downstream senior appropriator-plaintiffs had already been adjudicated by the United States District Court for the District of Arizona (Cause No. Civ. 321—Prescott) and affirmed by the Circuit Court of Appeals for the Ninth Circuit (Cause No. 14248), 229 Fed. 2d page 920, entitled Bagdad Copper Corporation, a corporation, Appellant, vs. John Phillip Zannaras and J. P. Robinson, Jr., Co-partners, and U. S. Tungsten Corporation, Appellees (the same parties involved herein), wherein ruling was made that the lack of water in Burro Creek for plaintiffs' use for 5 months of each year was caused by the upstream pumping by defendant.

9. The District Court erred in its ruling that the burden of proof was upon the downstream senior appropriator-plaintiffs to show that the lack of water for plaintiffs' use was the result of the junior appropriator upstream defendant's pumping.

10. The District Court erred in ruling that the evidence adduced was insufficient to enable the Court to determine as a fact that the use of water by an upstream junior appropriator was the result of the injury to the downstream senior appropriator.

11. The District Court erred in ruling that the burden of proof is upon the downstream senior appropriator to prove as a fact that the cause of its injury was attributable to the admitted pumping operations by the upstream junior appropriator.

12. The District Court erred in ruling for the defendant when the District Court found that the evidence was insufficient to enable the Court to determine that the act of the upstream junior appropriator-defendant resulted in the lack of water available for the downstream senior appropriator-plaintiffs.

13. The District Court erred in ruling in favor of the defendant and against the plaintiffs in that such ruling is contrary to the weight of the evidence.

14. The District Court erred in ruling that the downstream senior appropriator-plaintiffs are not entitled to an injunction against the upstream junior appropriator-defendant.

15. The District Court erred in ruling that the plaintiffs are not entitled to an injunction against the defendant in that the denial is contrary to the findings and evidence on file in the office of and testified to by the Arizona State Water Commissioner, an official of the State of Arizona, charged

by law with keeping records and making investigations.

16. The District Court erred in ruling against the plaintiffs and in favor of the defendant in that the burden of proof is upon one who changes its method and means of diversion to affirmatively show that such change in method and means of diversion will not damage downstream senior appropriator.

17. The District Court erred in denying relief to the plaintiffs when the defendant in its testimony asserted it was using large amounts of water for purposes other than for its own mining operations.

18. The District Court erred in not granting the injunctive relief sought by the plaintiffs when the evidence clearly discloses that the diversions by defendant for 5 months each year is depriving the plaintiffs of water to which they are entitled.

19. The District Court erred in failing to find as a fact that the plaintiffs were the senior and the defendant the junior appropriators of waters of Burro Creek, as the evidence conclusively proved such to be true, and the priority had been previously adjudicated by the United States District Court for the District of Arizona (Cause No. Civ. 321—Prescott) and affirmed by the Circuit Court of Appeals for the Ninth Circuit (Cause No. 14248), 229 Fed. 2d page 920, entitled Bagdad Copper Corporation, a corporation, Appellant, vs. John Phillip Zannaras and J. P. Robinson, Jr., Co-partners, and U. S. Tungsten Corporation, Appellees, (the same parties involved herein).

20. The District Court erred in not granting the injunctive relief sought by the downstream senior appropriator-plaintiffs when the evidence clearly discloses that the amount of water used by the upstream junior appropriator-defendant exceeds the amount of water to which it claims to be entitled under its certificate of water right.

21. The District Court erred in failing to require the upstream junior appropriator to affirmatively and specifically plead and affirmatively prove by clear, convincing and satisfactory evidence that the admitted use of water by such upstream junior appropriator does not deprive the downstream senior appropriator of the amount of water to which it is entitled.

22. The District Court erred in denying the application of the downstream senior appropriator for injunctive relief against the upstream junior appropriator in that the effect of such denial deprives the downstream senior appropriator of property without due process of law and without the payment of just compensation therefor.

Respectfully submitted,

MOEUR & JONES,

By /s/ ANTHONY O. JONES,
Attorneys for Appellants.

Receipt of copy acknowledged.

[Endorsed]: Filed July 25, 1957.

[Title of Court of Appeals and Cause.]

ORDER

The petition signed by the Attorneys for the Appellants and Appellee, having been considered by the Court, and the Court being fully advised in the premises, and no adverse interest appearing,

It Is Ordered that the following described exhibits need not be printed as a part of the Transcript of Record on appeal but may nonetheless be considered a part of the record on appeal for consideration of the Court to the extent such exhibits have legal significance in reaching a decision:

1949 Trial

Plaintiffs' exhibits numbered 2, 3, 4, 5 and 6

Defendant's Exhibits numbered B, C, D, E, I and J

1952 Trial

Plaintiffs' exhibits numbered 2, 3, 4, 5, 6 and 7

Defendant's exhibits numbered B, E, F and H

1954 Trial

Defendant's exhibits numbered Q, R, Y, Z, AB, AC and AD

It Is Further Ordered that the Transcript of Record in Cause No. 14248 in the United States Court of Appeals for the Ninth Circuit, entitled Bagdad Copper Corporation, a corporation, Appellant, vs. John Phillip Zannaras and J. P. Robinson, Jr., co-

partners, and U. S. Tungsten Corporation, Appellees, need not be printed by the Clerk of this Court as a part of the Transcript of Record in this cause, but the printed Transcript of Record as filed with the Clerk of the Circuit Court in said Cause No. 14248, including any and every exhibit therein legally applicable to this appeal, may be considered by the Court on this appeal insofar as evidentiary matters are contained therein legally applicable to Cause No. 221 in the District Court and on this appeal.

It Is Further Ordered that the Stipulation and Order do not prejudice the right of the Appellee herein to retain its legal position that this appeal cannot go behind the judgment of the United States District Court for the District of Arizona, dated January 2, 1951.

Dated this 6th day of August, 1957.

/s/ ALBERT LEE STEPHENS,
Chief Judge;

/s/ RICHARD H. CHAMBERS,
Circuit Judge.

Approved as to form:

MOEUR & JONES,

By /s/ ANTHONY O. JONES.
Attorneys for Appellants;

SNELL & WILMER,

By /s/ MARK WILMER,
Attorneys for Appellee.

[Endorsed]: Filed August 13, 1957.